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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
COUGHLAN, PETER D	
ART UNIT	**PAPER NUMBER**
2129	

DATE MAILED: 04/06/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/730,708	NUGENT, ALEX	
	Examiner	Art Unit	
	Peter Coughlan	2129	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 January 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *08 December 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Detailed Action

1. This office action is in response to an AMENDMENT entered January 16, 2006 for the patent application 10/730708 filed on December 8, 2003.

2. The First Office Action of January 3, 2006 is fully incorporated into this Final Office Action by reference.

Status of Claims

3. Claims 1-22 are pending.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 2, 3, 6 and 7 are rejected under 35 U.S.C. 102(b) (hereinafter referred to as **Nagahara**) being anticipated by Nagahara, 'Direct

placement of suspended carbon nanotubes for nanometer-scale assembly'.

5. Claim 1.

Nagahara anticipates providing a physical neural network comprising at least one neuron and at least one synapse thereof, wherein said at least one synapse is formed from a plurality of nanoparticles disposed within a dielectric solution in association with at least one pre-synaptic electrode and at least one post-synaptic electrode thereof and an electric field applied thereof; and transmitting at least one pulse generated from said at least one neuron to said at least one post-synaptic electrode of a said at least one neuron and said at least one pre-synaptic electrode of said at least one neuron of said physical neural network, thereby strengthening at least one nanoconnection of said plurality of nanoparticles disposed within said dielectric solution and said at least one synapse thereof (**Nagahara**, page 3826:C1:35 through C2:8; The two electrodes and the gap between them are the pre and post electrodes and the synapse of applicant. By applying an electric supply, a connection between these two electrodes is generated by the CNTs which are in solution. This connection or link is the neuron.)

In reference to applicants arguments.

Regarding claim 1, the Examiner argued that Bezryadin teaches providing a physical neural network comprising at least one neuron and at least one synapse thereof, wherein said at least one synapse is formed from a plurality of nanoparticles disposed within a dielectric solution in association with at least one pre-synaptic electrode and at least one post-synaptic electrode thereof and an electric field applied thereof (i.e., the Examiner cited Bezryadin, page 2: lines 12-

14); and transmitting at least one pulse generated from said at least one neuron to said at least one post-synaptic electrode of said at least one neuron and said at least one pre-synaptic electrode of said at least one neuron of said physical neural network, thereby strengthening at least one nanoconnection of said plurality of nanoparticles disposed within said dielectric solution and said at least one synapse thereof (Le., the Examiner cited Bezryadin, page 2, lines 14-19). The Examiner provided an Examiner's Note (EN) that argued that 'synapse' of Applicant Is equivalent to 'transport properties of Bezryadin.

The Applicant disagrees with this assessment. Although the Examiner referred to the Bezryadin reference with respect to the rejection to claim 1, the Examiner did not refer to Mehrotra, Middleton or Tapang as part of the Examiner's argument with respect to claim 1. As such, the Examiner's arguments rejecting claim 1 are silent with respect to Mehrotra, Middleton, and Tapang.

Regarding the Mehrotra reference, the Applicant notes that Mehrotra does not provide any teaching or suggestion of a physical neural network based on nanotechnology components, but only relates to "artificial neural networks" that are algorithm/software based. Mehrotra provides plenty of examples of algorithms, but does not provide for any implementation whatsoever of a physical neural network. Mehrotra also does not provide for any teaching or suggestion of nanotechnology. The Examiner has not explained how Mehrotra suggests or teaches a aanotechnoloay based physical neural network (as opposed to an algorithmic/software based neural network).

Regarding the Middleton reference, the Applicant notes that Middleton does not provide any teaching or suggestion for any type of neural network and/or neural network components, either software or physical based neural networks. Middleton only relates to collective transport in arrays of small metallic dots, but again does not provide for any hint or suggestion of physical neural networks and/or neural network components.

Middleton does not describe a synapse, a neuron, and/or a neural network. Middleton also does not teach any type of device that processes information but instead teaches physically modeling the collective conductance properties of an ordered array of quantum dots. By citing Middleton, the Examiner is attempting to ascribe a similarity between a `network' of two dimensional ordered quantum dots cooled to 200 degrees below zero and permanently bound to a chip surface under a vacuum with a physical neural network formed by the dipole induced aggregation of nanoparticles in a liquid solution between pre- and post-synaptic electrodes which are receiving electronic feedback from dedicated neural circuitry. The comparison between Applicant's invention and Middleton is therefore flawed.
Regarding the Tapang reference, the Applicant notes that Tapang provides absolutely no teaching of nanotechnology based components. In fact, the various electrical components taught by the Tapang reference teach away from nanotechnology components and focus instead on large electrical components

for forming neural connections, such as, for example, the various transistors, amplifiers, and so forth depicted in FIGS. 1-11 of Tapang. These components clearly teach away from nano-sized components.

Tapang does not teach or suggest the use of nanoparticles as a synapse. Tapang describes a method for refreshing capacitively stored synaptic weights (i.e., see first sentence of Tapang). It has been demonstrated that capacitively stored synaptic weights are limited in their ability to form very large and adaptive physical neural systems. The use of nanoparticles as a synapse as taught by Applicant's invention alleviates this problem. In other words, Applicant's invention claims a solution to a problem inherent in the design of Tapang..

Regarding Bezryadin, page 2: lines 12-14, the Applicant notes that Bezryadin does not provide any teaching, hint or suggestions for a physical neural network, one or more neurons, pre-synaptic and post-synaptic electrodes, and, a plurality of nanoparticles disposed within a dielectric solution in association with at least one pre-synaptic electrode and at least one post-synaptic electrode thereof and an electric field.

Page 2, lines 12-14 of Bezryadin indicates only that the process of electrostatic self-assembly takes place between a pair of voltage biased microelectrodes, immersed In a dielectric liquid with suspended nanoparticies" and that "the electric field generated between the electrodes polarizes conducting particles and, due to dipole-dipole attraction, leads to formation of a continuous chain which links the electrodes". Where does this language teach all of the following elements of Applicant's claims 1: a physical neural network, one or more neurons, pre-synaptic and post-synaptic electrodes, and a plurality of nanoparticles disposed within a dielectric solution in association with at least one per –svnaptic electrode and at least one post-svnaptic electrode thereof and an electric field? For that matter, where does Bezryadin provide a teaching or hint of a physical neural network? The Examiner has failed to provide any citations from Bezryadin, which teach or hint at the creation of a physical neural network. The combination of all of Applicant's claim 1 elements is simply not taught or suggested by Bezryadin.

Page 2, lines 14-19 of Bezryadin also does t]4 provide for any hint or suggestion of all of the following claim limitations: t r a n s m g at least one pulse generated from said at least one m u m to said at least one post-synaptJ electrode of said at least one neuron and said at least one_p.l ynaptic electrode of said at least one neuron of said physical neural network, thereby strengthentnq at least one nanoconnection of said plurality of nanoparticles disposed within said dielectric solution and said at least one synapse thereof. Page 2, lines 14-19 of Bezryadin only indicates that "...here we demonstrate that this mechanism, if used on the micrometer scale, can produce continuous and electrically conducting chains of nanoparticles with very interesting and possibly useful transport properties". Such language does not provide any teaching or suggestion of a transmitting step,

pulses generated from one or more neurons, transmission of the pulse to one or more post-synaptic electrodes and one or more pre-synaptic electrodes, a physical neural network and the resulting strengthening of one or more nanoconnections of the physical neural network.

The Examiner's Note (EN) suggesting that the `synapse' of Applicant is equivalent to 'transport properties' of Bezryadin is clearly Improper because as indicated above, the reference 'transport properties' of Bezryadin provides absolutely act suggestion, hint or teaching of a synapse, and/or for that matter, neurons, neural networks, and so forth. . i is "transport properties" of Bezryadin equivalent to Applicant's "synapse"? The Examiner has not provided any evidence of how "transport properties" is equivalent to the Applicant's "synapse", Bezryadin simply does not teach or imply a physical neural network, Including adaptive synapses and associated neurons. Bezryadin deals exclusively with creating long chains of conducting nanoparticles and their potential use as links in coulomb charge memories. These memories rely on quantum transport phenomena and are not Intended to be used in a li^q^uid environment. The EN asserting that a synapse is equivalent to transport properties of Bezryadin and reference to page 2: 14-19 of Bezryadin is thus simply incorrect. It Is clear that Bezryadin intends transport phenomena to refer to quantum effects, more specifically a coulomb threshold. This passage of Bezryadin reads:

The electric field generated between the electrodes polarizes conducting particles and, due to the dipole-dipole attraction, leads to formation of a continuous chain which links the electrodes. Note that this chain formation effect is responsible for different electroheological phenomena and was studied In macroscopic systems in this context. Here we demonstrate that this mechanism, if used on the micrometer scale, can produce continuous and electrically conducting chains of nanoparticles with very interesting and possible useful transport properties. Our samples exhibit a Coulomb threshold behavior up to rather high temperatures (t-·77 K), even though we use relatively big particles of diameter-·30nm.

It is clear that Bezryadin does not intend adaptive connections to persist in a liquid at 77K. Bezryadin further states on page 3: 9-10 that "Immediately after [the connection forms], the substrate is rinsed gently, dried and cooled down," Thus, it is clear that Bezryadin does aqt intend an adaptive synapse because Bezryadin removes the liquid medium necessary for synaptic adaptation. Bezryadin uses the electrostatic assembly of nanoparticles as a mechanism to build a single continuous chain of particles, but the transport properties studied are clearly not in a liquid and the connection does not adapt.

The Applicant further notes that the Examiner's arguments with respect to claim 1 fail under all three prongs of the aforementioned prima facie obviousness test. Under the first prong of the aforementioned prima facie obviousness test, in order to establish a rejection under 35 U.S.C. 103, the Examiner must provide some suggestion or motivation, either in the references themselves or in the

knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings in order to achieve alb. of the claim limitations of Applicant's rejected claim(s). In this case, the Examiner has failed to identify some suggestion or motivation in the Bezryadin reference for achieving all of the claim limitations of Applicant's amended claim 1.

Regarding the issue of motivation, the Applicant reminds the Examiner that the language of the references may not taken out of context and combined without motivation, in effect producing the words of the claims (and sometimes, not even the words or concepts of the claims), without their meaning or context. The resultant combination would not yield the invention as claimed. The claims are rejected under 35 U.S.C, §103(a) and no showing has been made to provide the motivation as to why one of skill in the art would be motivated to make such a combination, and further fails to provide the teachings necessary to fill the gaps in these references in order to yield the invention as claimed. The rejection to claim 1. under 35 U.S.C. §103(a) has provided no more motivation than to simply point out the individual words of the Applicant's claims among the references, but without the reason and result as provided in the Applicant's claims and specification, and without reason as to why and how the references could provide the Applicant's invention as claimed. Hindsight cannot be the basis for motivation, which is not sufficient to meet the burden of sustaining a 35 U.S.C. §103(a) rejection.

Regarding the second prong of the aforementioned prima facie obviousness, the Examiner has not provided a "reasonable expectation of success" for modifying Bezryadin as suggested by the Examiner to achieve all of the claim limitations of Applicant's claim 1, particularly where as indicated above, the Bezryadin reference does not provide any teaching or hint of a neural network and neural network components. It is not generally enough that the Bezryadin reference suggest the combination of claim elements recited in Applicant's claim 1; there must also be some reasonable expectation of success for the suggested combination. See In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Regarding the third prong of aforementioned prima facie obviousness test, the Examiner has also not identified the teaching or suggestion of a it the claim limitations by the Bezryadin reference (or references when combined). Where does the Bezryadin reference provide for a hint of All of the claim limitations of Applicant's claim 1? Based on the foregoing, the Applicant submits that the rejection to claim 1 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 1.

Examiner's response

New art had been introduced so applicant's arguments are irrelevant.

6. Claim 2.

Nagahara anticipates increasing an electrical frequency of said electric field applied to said at least one pre-synaptic electrode and said at least one post-synaptic electrode, in response to generating said at least one pulse said at least one neuron, thereby strengthening at least one nanoconnection of said plurality of nanoparticles disposed within said dielectric solution and said at least one synapse thereof (**Nagahara**, page 3827 C1:26-36, p3826 C2:6-8 and Figs 3 and 4; By increasing the frequency the connection has lower contamination thus a strengthening between the nodes.).

In regards to applicants arguments.

Regarding daim 2, the Examiner argued that Bezryadin teaches increasing an electrical frequency of said electric field applied to said at least one pre-synaptic electrode and said at least one post-synaptic electrode, in response to generating said at least one pulse said at least one neuron, thereby strengthening at least one nanoconnection of said plurality of nanoparticles disposed within said dielectric solution and said at least one synapse thereof. In support of the rejection to claim 2, the Examiner cited Page 3, lines 7-9 of Bezryadin.

The Applicant respectfully disagrees with this assessment and notes that the arguments presented above against the rejection to claim 1 apply equally against the rejection to claim 2 because daim 2 depends from claim 1. Regarding Page 3, lines 7-9 of Bezryadin, the Applicant notes that this citation does not provide any teaching or disclosure of the step of increasing an electrical frequency of said electric field applied to said at least one pre-synaptic electrode and said at least one post-synaptic electrode, in response to generating said at least one pulse said at least one neuron, thereby strengthening at least one nanoconnection of said plurality of nanoparticles disposed within said dielectric solution and said at least one synapse thereof. Page 3, lines 7-9 of Bezryadin indicates only that "after a few seconds it increases suddenly by a few orders of magnitude...this indicates that the first continuous chain has been formed...immediately after this current jump, the substrate is rinsed gently, dried and cooled down."

Page 3, lines 7-9 of Bezryadin does not teach or disclose an electrical frequency, an electric field, one or more pre-synaptic and sXnapxic electrodes, an

increasing step that occurs jn respanse to a Ise _generatin9 step, one or more pstl_s_e generated by one or more neuron, and the strengthening of one or more nanoconnections and one or more synapses thereof. All, foregoing claim elements are not taught or suggested by Page 3, lines 7-9 of Bezryadin as argued by the Examiner. Additionally, Page 3, lines 7-9 of Bezryadin does not teach all such elements in the context of a nanotechnology based physical neural network.

As indicated previously Bezryadin does not provide any hint or motivation for forming a physical neural network based on nanotechnology. A physical neural network is more than a mere trivial modification of Bezryadin. To establish a nanotechnology-based physical neural network, a number of factors need to be present and arranged in a particular combination. How would one be motivated by Bezryadin to provide for the entire claim limitations of Applicant's claims? The Examiner has not provided such a motivation because such a motivation cannot be found in Bezryadin. The Examiner also had not identified each and every claim limitation of Applicant's claim 2 (which incorporates all of the claim limitations of Applicant's claim 1) in the Bezryadin reference. It is important to note Bezryadin does not teach increasing an electric frequency of an applied electric field, and in fact explicitly states that the field used is electrostatic (see page 2, line 12 of Bezryadin). An electrostatic field has, by definition, no frequency components. The Examiner has also referenced page 3: 7-9 of Bezryadin which reads:

"Initially the current between the electrodes is very low, I< I OpA. After a few seconds it increases suddenly by a few order of magnitude. This indicates that a chain has been formed. Immediately after this current jump, the substrate is rinsed gently, dried and cooled down."

This does not indicate an increased electrical frequency or electrical magnitude in response to a pulse being generated by a neuron. If Bezryadin intended to adaptively control the synapse, Bezryadin would not have stopped the experiment when the connection was formed. In fact, removing the force that generates the connection after the connection has formed is exactly opposite in reasoning to what is claimed in Applicant's claim 2.

Based on the foregoing, the Applicant submits that the rejection to claim 2 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 2.

Examiner's response.

New art had been introduced so applicant's arguments are irrelevant.

7. Claim 3.

Nagahara anticipates forming a connection network from said plurality of nanoparticles by applying said electric field to said at least one pre-synaptic electrode and said at least one post-synaptic electrode associated with said plurality of nanoparticles (**Nagahara**, Page 3826 C1:35 through C2:8; Nanoparticles of applicant is equivalent to CNT of Nagahara. Applying the electrical field of applicant is equivalent to 1 MHz of Nagahara.).

In response to applicants arguments.

Regarding claim 3, the Examiner argued that Bezryadin teaches forming a connection network from said plurality of nanoparticles by applying said electric field to said at least one pre-synaptic electrode and said at least one post-synaptic electrode associated with said plurality of nanoparticles. In support of this argument, the Examiner cited Page 2, lines 4-10 of Bezryadin. The Examiner also provided an Examiner's Note (EN), asserting that the 'connection network' of Applicant's claim 3 is equivalent to '1D Arrays' of Bezryadin.
The Applicant respectfully disagrees with this assessment and notes that the arguments presented above against the rejection to claim 1 apply equally to the rejection to claim 3. Bezryadin does not teach the formation of a connection network from a plurality of nanoparticles. The EN refers to page 2:4-10 of Bezryadin and argues that a connection network is equivalent to `1D arrays' of Bezryadin. Page 2:4-10 of Bezryadin reads as follows:

"Collective charge pinning is predicted for disordered arrays. Such systems enter a conducting state only above a certain threshold voltage, which increases with the number of islands in the array. Therefore 1D arrays can serve as switchabie electronic links for coulomb charge traps. High operation temperatures and good reproducibility could be achieved if the arrays are composed of nanometer scale metallic particles synthesized chemically. New approaches should be developed in order to organize such nanoparticies into useful electronic devices."

The Examiner has misconstrued the language of Page 2: 4-10 of Bezryadin, which actually refers to a static Island of small metallic islands weakly coupled by quantum mechanical tunneling, cooled about 200 degrees below zero. There is n.Q liquid present in the final device, nor is there adaptation, A connection network necessarily requires a plurality of conducting connections formed into a network, In a liquid, between pre- and post-synaptic neural circuits, which is taught by Applicant's invention.

Page 2, lines 4-10 of Bezryadin refers to systems entering a conductive state above a certain threshold voltage, which Increases with the number of islands in an array and that 1D arrays can serve as switchabie electronic links for Coulomb charge traps. Page 2, lines 4-10 of Bezryadin does not provide any suggestion, however, that the 1D Arrays of Bezryadin could be modified to act as Applicant's connection network, which forms a part of Applicant's physical neural network.

The Examiner has not provided any evidence to the contrary other than simply to cite Page 2, lines 4-10 of Bezryadin and provide an EN stating without a justification that the 1D Arrays" of Bezryadin are equivalent to Applicant's "connection network"

The "1D Arrays" of Bezryadin are not equivalent to Applicant's "connection network" because an array is not a network. The 1D array of Bezryadin cannot function as a connection network of a physical neural network as taught by Applicant's invention.

Additionally Bezryadin refers to "continuous chains", A chain Is essentially a serial device, whereas Applicant's connection network and physical neural network constitute a system and hence a network that Is non-serial in nature, Applicant notes that a true neural network, such as that disclosed by Applicant's invention, is massively parallel (and therefore very fast computationally) and very adaptable. The essentially serial and "continuous chains" of Bezryadin thus teach away from parallel devices due to the "continuous" and continuity of the continuous chains of Bezryadin.

Based on the foregoing, the Applicant submits that the rejection to claim 3 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 3.

Examiners response.

New art had been introduced so applicant's arguments are irrelevant.

8. Claim 6.

Nagahara anticipates providing a physical neural network comprising a plurality of neurons formed from a plurality of nanoconnections disposed within a dielectric solution in association with at least one pre-synaptic electrode and at

least one post-synaptic electrode; activating said subsequent neuron in response to firing an initial neuron of said plurality of neurons, thereby increasing a voltage of a pre-synaptic electrode of said neuron, which causes a refractory pulse thereof to decrease a voltage of a post-synaptic electrode associated with said neuron and thus provides an increased voltage between said pre-synaptic electrode of said preceding neurons and said post-synaptic electrode of said neuron (**Nagahara** page3827 C1:37 through C2:22; Increasing the voltage of applicant is equivalent to AC bias of Nagahara.).

In response to applicants arguments.

Regarding claim 6, the Examiner argued that Bezryadin teaches providing a physical neural network comprising a plurality of neurons formed from a plurality of nanoconnections disposed within a dielectric solution in association with at least one pre-synaptic electrode and at least one post-synaptic electrode (citing Bezryadin, Page 2, lines 7-14); activating said subsequent neuron in response to firing an initial neuron of said plurality of neurons, thereby increasing a voltage of a pre-synaptic electrode of said neuron, which causes a refractory pulse thereof to decrease a voltage of a post-synaptic electrode associated with said neuron and thus provides an increased voltage between said pre-synaptic electrode of said preceding neurons and said post-synaptic electrode of said neuron (citing Bezryadin, Page 2, lines 14-19).

The Applicant respectfully disagrees with this assessment. Bezryadin does not teach providing a physical neural network comprising a plurality of neurons formed from a plurality of nanoconnections disposed within a dielectric solution, but rather deals exclusively with the formation of a particle chain that is used as the basis for a quantum mechanical transport study dealing with coulomb blockades.

Bezryadin also does not teach activating said subsequent neuron in response to firing an initial neuron of said plurality of neurons, thereby increasing a voltage of a pre-synaptic electrode of said neuron, which causes a refractory pulse thereof to decrease a voltage of a post-synaptic electrode associated with said neuron and thus provide an increased voltage between pre-synaptic electro of said preceding neurons and said post-synaptic electrode of said neuron. Rather, Bezryadin has no analog of a neuron, or a refractory pulse. Rather, Bezryadin states (see page 3, line 9 of Bezryadin) that "immediately after this current jump, the substrate is rinsed gently, dried and cooled down." This statement lies in direct

contradiction to the generation of an increased voltage because Bezryadin removed both the field and the liquid. If this connection was used as the basis of an adaptive neuron Bezryadin would have had to provide dedicated electronic circuitry to fire a refractory pulse across a post-synaptic electrode to reinforce the connection. Instead, Bezryadin has no neuron, removes the field, washes the connection, dries it, and the cools it to 200 degrees below zero (Celsius). Bezryadln thus fails to teach all of the following claim limitations: a neural network, a physical neural network, pre-synaptic and post synaptic electrodes, one or more neurons, activation of a subsequent neuron, in response to firing an Initial neuron, increasing a pre-synaptic voltage, a refractory pulse, a decrease in a post-synaptic voltage, and an increased voltage between the pre-synaptic and post-synaptic electrodes. Page 2, lines 7-14 and lines 14-19 of Bezryadin do not teach all of these aforementioned claim limitations let along the providing and activation steps of claim 6. The Examiner has not provided any evidence to the contrary.

As such, the Applicant submits that the rejection to claim 6 fails under all three prongs of the aforementioned prima facie obviousness test. Under the first prong of the aforementioned prima facie obviousness test, in order to establish a rejection under 35 U.S.C. 103, the Examiner must provide some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings in order to achieve all of the claim limitations of Applicant's rejected claim(s). In this case,. the Examiner has failed to identify some suggestion or motivation in the Bezryadin reference for achieving all of the claim limitations of Applicant's claim 6.

Regarding the issue of motivation, the Applicant reminds the Examiner that the language of the references may not taken out of context and combined without motivation, in effect producing the words of the claims (and sometimes, not even the words or concepts of the claims), without their meaning or context. The resultant combination would not yield the invention as claimed. The claims are rejected under 35 U.S.C. §103(a) and no showing has been made to provide the motivation as to why one of skill In the art would be motivated to make such a combination, and further fails to provide the teachings necessary to fill the gaps in these references in order to yield the invention as claimed. The rejection to claim 6 under 35 U.S.C. §103(a) has provided no more motivation than to simply point out the individual words of the Applicant's claims among the references, but without the reason and result as provided in the Applicant's claims and specification, and without reason as to why and how the references could provide the Applicant's invention as claimed. Hindsight cannot be the basis for motivation, which is not sufficient to meet the burden of sustaining a 35 U.S.C. §103(a) rejection.

Regarding the second prong of the aforementioned prima facie obviousness, the Examiner has not provided a "reasonable expectation of success" for

modifying Bezryadin as suggested by the Examiner to achieve all of the claim limitations of Applicant's claim 6, particularly where as indicated above, the Bezryadin reference does not provide any teaching or hint of a neural network and neural network components. It is not generally enough that the Bezryadin reference suggest the combination of claim elements recited in Applicant's claim 6; there must also be some reasonable expectation of success for the suggested combination.

Regarding the third prong of aforementioned prima facie obviousness test, the Examiner has also not identified the teaching or suggestion of All the claim limitations by the Bezryadin reference (or references when combined). Where does the Bezryadin reference provide for a hint and/or teaching of all of the claim limitations of Applicant's claim 6? Based on the foregoing, the Applicant submits that the rejection to claim 6 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 6.

Examiners response.

New art had been introduced so applicant's arguments are irrelevant.

9. Claim 7.

Nagahara teaches and activating subsequent neurons thereof in succession in order to produce an increased frequency of an electric field between subsequent pre-synaptic and post-synaptic electrodes thereof, thereby causing an increase in an alignment of at least one nanoconnection of said plurality of nanoconnections and a decrease in an electrode resistance between said subsequent pre-synaptic and post-synaptic electrodes thereof. (**Nagahara,** p3826 C2:6-8; With the connection being made the resistance will decrease.)

In response to applicants arguments.

Regarding claim 7, the Examiner admitted that Bezryadin and Mehrotra do not teach firing and activating subsequent neurons thereof in succession in order to produce an increased frequency of an electric field between subsequent pre-synaptic and post-synaptic electrodes thereof, thereby causing an increase in an alignment of at least one nanoconnection of said plurality of nanoconnections and a decrease in an electrode resistance between subsequent pre-synaptic and

post-synaptic electrodes thereof. The Examiner argued, however, that Middleton teaches firing and activating subsequent neurons thereof in succession in order to produce an increased frequency of an electric field between subsequent pre-synaptic and post-synaptic electrodes thereof, thereby causing an increase in an alignment of at least one nanoconnection of said plurality of nanoconnections and a decrease in an electrode resistance between said subsequent pre-synaptic and post-synaptic electrodes thereof. In support of this argument, the Examiner cited Middleton, page 3198, C1:21-25 and set forth an EN, arguing that the "decrease in an electrode resistance" of the Applicant is equivalent to an "increase in conductivity" of Middleton).

The Examiner argued that it would have been obvious to a person having ordinary skill In the art at the time of the Applicant's invention to modify the combined teachings of Bezryadin and Mehrotra by an increase in the electrical field (arguing increased frequency) improves the conductivity state of the nanoparticles as taught by Middleton to have firing and activating subsequent neurons thereof in succession in order to produce an increased frequency of an electric field between subsequent pre-synaptic and post-synaptic electrodes thereof, thereby causing an Increase in an alignment of at least one nanoconnection of said plurality of nanoconnections and a decrease in an electrode resistance between said subsequent pre-synaptic and post-synaptic electrodes thereof. The Examiner started the purpose being is to have the ability of charging the output based on the connectivity of the nanoparticles.

The Applicant respectfully disagrees with this assessment and notes that the arguments presented above against the rejection to claim 6 apply equally to the rejection to claim 7. Middleton does Apt teach firing and activating subsequent neurons thereof in succession in order to produce an increased frequency of an electric field between subsequent pre-synaptic and post-synaptic electrodes, thereby causing an increase in alignment of at least one nanoconnection of said plurality of nanoconnections and a decrease in an electrode resistance between said subsequent pre-synaptic and post-synaptic electrode thereof.

Middleton's paper studies the low-temperature, nonlinear charge transport in one and two-dimensional arrays of small normal-metal dots separated by tunnel barriers. The increase in conductivity sited by the examiner (P 3198, Cl: 21-25 of Middleton) is the result of a quantum mechanical phenomena between stationary conducting metal islands arranged in a two-dimensional grid. In no case do these conducting islands actually move or align, nor are they dispersed in a liquid, nor could the particles even be disposed in a liquid at the temperatures studied. The connectivity of the particles do not change, and in fact the notion of "connectivity" is not even defined in this experiment. The experimental setup, as described by Middleton, requires a grid of metallic nanoparticles cooled to very low temperatures and placed in a vacuum, which is quite different than nanoparticles free to move around in a liquid environment at room temperature. As described by Middleton, at no time do the metal dots physically move or align in

response to an applied electric field. Middleton does not describe any relation or relevance to neural networks.

The Examiner has not identified specifically, which aspects of Middleton teach all of the following claim limitations of Applicant's claim 7: the step of firing and activating subsequent neurons thereof in succession in order to produce an increased frequency of an electric field between subsequent pre-synaptic and post synaptic electrodes thereof, thereby causing an increase in an alignment of at least one nanoconnection of said plurality of nanoconnections gnd a decrease in an electrode resistance between said subsequent pre-synaptic and post-synaptiq electrodes thereof.

Middleton does not provide for any teaching or suggestion of a neural network and/or neural network components. As such, because Middleton does not provide for any teaching or suggestion of a neural network and/or neural network components, the Applicant submits that it Is improper to combine Middleton with a reference that does. That is, in order to for Middleton to properly be combined with another reference as a basis for teaching a physical neural network formed utilizing nanotechnology, at a minimum Middleton should possess some teaching or suggestion of a physical neural network. Middleton provides absolutely no teaching of a neural network or neural networks. In fact, Middleton does not even provide for a teaching of any other type of artificial neural networks (e.g., software based neural networks). Additionally, Middleton does not provide for any teaching or suggestion of nanoparticles disposed in a dielectric solution for the purpose of forming a physical neural network.

Regarding the Examiner's reference to Middleton, page 3198, 01:21-25, the Applicant notes that this citation indicates only that "...this sharp onset is to be contrasted with conduction in one- and two-dimensional disordered materials, where an increasing electric field leads to a smooth increase in conductivity." No reference is made here to all of the following: firing and activating subsequent neurons, thereof in succession in order to produce an increased frequency of an electric field between subsequent pre-synaptic and post-synaptic electrodes thereof, thereby causing an increase in an alignment of at least one nanoconnection of said plurality of nanoconnections and a decrease in an electrode resistance between said subsequent pre-synaptic and post-synaptic electrodes thereof. No reference Is also made here to a neural network, a physical neural network, neural network components, neurons, synapses, and so forth.

Regarding the EN, arguing that the "decrease in an electrode resistance" of the Applicant is equivalent to an "increase in conductivity" of Middleton, the Applicant notes that any Increase in conductivity of Middleton is due to any presence of a neural network, neural network components, neurons, synapses, and so forth, simply because such complicated devices and components are simply t taught or suggested by Middleton. Based on the foregoing, the Applicant submits that the

rejection to claim 7 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 7.

Examiners response.

New art had been introduced so applicant's arguments are irrelevant.

Claim Rejections - 35 USC § 103

10. Claims 5 and 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahara, as set forth above, in view of Mehrotra ('Elements of Artificial Neural networks', referred to as **Mehrotra).**

11. Claims 5 and 8.

Nagahara does not teach physical neural network comprises an adaptive neural network. Mehrotra teaches physical neural network comprises an adaptive neural network (**Mehrotra**, pages 116-135). It would have been obvious to a person having ordinary skill in the art at the time of applicant's invention to modify teachings of Nagahara by illustrating in some detail the contents of an adaptive neural network is a subclass of neural networks as taught by Nagahara to teach physical neural network comprises an adaptive neural network.

The purpose being the adaptive neural network can be pruned to handle the task at hand.

In reference to the Applicant's argument:

Regarding claims 5, 8 and 22, the Examiner admitted that Bezryadin does not teach a physical neural network comprising an adaptive neural network. The Examiner argued, however, that Mehrotra at pages 116-135 teaches an adaptive neural network. The Examiner thus argued that it would have been obvious to a person having ordinary skill in the art at the time of Applicant's invention to modify teachings of Bezryadin by illustrating in some detail the contents of an adaptive neural network is a subclass of neural networks as taught by Bezryadln to teach physical neural network comprises an adaptive neural network. The Examiner stated that "the purpose being the adaptive neural network can be pruned to handle the task at hand".

The Applicant respectfully disagrees with this assessment and notes that arguments presented above against the rejection to claim 1 can also apply to the rejection to claims 5, 8 and 22. The Applicant further notes that Mehrotra at pages 116-135 provides not hint or suggestion of a physical neural network or for that matter, a nanotechnology based physical neural network. Mehrotra also does not provide any hint or suggestion and/or teaching of nanotechnology and nanotechnology-based devices and components. In fact, Mehrotra at pages 116-135 provides algorithms and teachings for a software based neural network and not a physical neural network.

As indicated in Applicant's specification, software networks have been developed. Because software simulations are performed on conventional sequential computers, however, they do not take advantage of the inherent parallelism of neural network architectures. Consequently, they are relatively slow. Mehrotra does not teach physical neural networks but focuses on artificial neural networks that are software (algorithm) based. For example, Page 117 of Mehrotra, Figure 4.6 refers to a "generic network pruning algorithm". Page 117 of Mehrotra also refers to an "optimal brain surgeon algorithm," which again can only be implemented in the context of software because Mehrotra provides no teaching for nanotechnology or nanotechnology based neural networks. Additionally, page 4 of Mehrotra refers to "Marchand's algorithm". Also, Figure 4.7, page 119 of Mehrotra shows an adaptive network algorithm but not a physical neural network. Page 134, Figure 4.21 of Mehrotra teaches a tiling algorithm, but again not a physical neural network.

The Applicant reminds the Examiner that in order to combine one or more references as a basis for a rejection to a claim under 35 U.S.C. 103(a), there must be a hint or suggestion in each reference for combining the references to provide for a rejection of the claim limitations. In this case, there is no hint or suggestion of either a physical neural network, a nanotechnology based physical neural network, and/or nanotechnology and nanotechnology-based devices and components in Mehrotra. In fact, as indicated above, Mehrotra teaches away

from physical neural networks and focuses instead on algorithms (i.e., software). It is therefore improper to combine Mehrotra with Bezryadin, Middleton and/or Tapang as suggested by the Examiner because Mehrotra provides no teaching of
nanotechnology components/devices and additionally no teaching for a physical neural network. The Applicant also notes that the presence of an adaptive" aspect to Mehrotra is irrelevant, because Mehrotra cannot be properly combined with Bezryadin, Middleton and/or Tapang due to the lack of a teaching or suggestion by Mehrotra of nanotechnology and physical neural networks.

The Examiner has stated that it would have been obvious to a person having ordinary skill in the art at the time of applicant's invention to modify the teaching of Bezryadin by illustrating in some detail the contents of an adaptive neural network is a subclass of neural networks as taught by Bezryadin to teach physical neural network comprises an adaptive neural network. The purpose being the adaptive neural network can be pruned to handle the task at hand."

There are many reason why this reasoning is not correct. First, it should be noted that Bezryadin does not teach or imply physical neural networks as discussed earlier, but instead deals exclusively with the formation of a particle chain that is utilized as the basis for a quantum mechanical transport study dealing with coulomb blockades.

Mehrota does not teach an adaptive synaptic connection, which is the basis of Applicant's patent application. Rather, "adaptive" is used by Mehrotra in the context of adaptively creating and removing neural nodes from a software/algorithmic based neural network. Removing a neuron in a physical neural network would be consistent with transistors spontaneously disappearing and reappearing on a chip, which is not possible. All pruning algorithms described in the Mehrotra paper naturally require the Insertion and deletion of neural nodes, which is logically not possible in a physical neural network such as that of Applicant's invention, where neural nodes are built from dedicated circuitry.

Mehrota's survey paper dealing with pruning a neural network is the result of the computational constraints of a neural network when emulated on a traditional computer. The fewer connections that have to be calculated the faster the computer will be able to compute the network. Mehrota states (first sentence) "Small networks are more desirable than large networks that perform the same task, for several reason: training is faster, the number of parameters in the system is smaller, fewer training samples are needed, and the system Is more

likely to generalize well for new test samples." Mehrota then goes on to review a number of pruning algorithms for achieving the goal of a smaller network.

If Mehrota had intended a physical neural network, it is apparent that training would not be faster because each neural node and its associated connections are independent. Thus, a small network will adapt at the same rate as a large network. In addition, in a physical network, the number of parameters in the network is irrelevant because the parameters do not have to be calculated by a serial processor. In addition, the requirement of fewer training samples is irrelevant in a continuously adapting physical neural network because there is no inherent distinction between training and "non training" samples. For the network to adapt it must process information, which requires a constant stream of data.

The need for a physical neural network is an observation of exactly the opposite nature to that taught in Mehrota: biological neural systems are incredibly large and self-adapting. If we cannot Find a way to create large self-adapting networks then we will not be able to design networks capable of biological capability. In other words, Mehrota's paper does not provide a basis for obviousness because the entire paper is aligned in a direction completely opposite to that of a physical neural network, that of mathematically, not physically] simulating smaller networks. The computational load of a large neural network is exactly the reason why a physical neural network is needed. Rather than calculating the network, the network is built neuron for neuron and synapse for synapse. This removes any computational problems. If anything, Mehrota is helpful in illustrating why the concept of a physical neural network is a novel solution to a difficult problem because his solution is exactly contradictory to a physical neural network.

Based on the foregoing, the Applicant submits that the rejection to claims 5, 8 and 22 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claims 5, 8 and 22. The Applicant also notes that all of the arguments presented above against the Mehrotra reference apply equally against the rejection of all other claims rejected by the Examiner wherein Mehrotra is referenced.

Examiner's response.

Mehrotra teaches the components and design of an adaptive neural network. Examiner does not claim that Mehrotra comprises of nanotechnology. Mehrotra teaches neural networks. The combination of Mehrotra and Nagahara is obvious. Mehrotra teaches algorithms due to the fact the author uses software

based neural networks as an example but does not limit them to software only. It would even be more obvious to combine an adaptive neural network design rather than a standard neural network design with that of Nagahara. Due to the fact that Nagahara has the property of making connections between electrodes when required. In terms of training Mehrotra uses the example of a software based neural network. Mehrotra does not limit the existence to software based systems only. The combination of the adaptive neural networks of Mehrotra and dynamic abilities of Nagahara is obvious.

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(b) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 9, 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nagahara in view of Mehrotra, and further in view of Olson ('Directed placement of suspended carbon nanotubes for nanometer-scale assembly': referred to as **Nagahara**; 'Elements of Artificial Neural

Networks', referred to as **Mehrotra**; 'Startup combines nanotechnology with neural nets', referred to as **Olsen**).

13. Claim 9.

Nagahara teaches configuring an adaptive physical neural network to comprise a plurality of nanoparticles located within a dielectric solution, wherein said plurality of nanoparticles experiences an alignment with respect to an applied electric field to form a connection network thereof (**Nagahara,** p3826 C1:35 through C2:8),

Nagahara does not teach that said adaptive physical neural network.

Mehrotra teaches that said adaptive physical neural network. (**Mehrotra,** pages 116-135). It would have been obvious to a person having ordinary skill in the art at the time of applicant's invention to modify combined teachings of Nagahara to include the design of the adaptive neural network of Mehrotra.

For the purpose of taking advantage of the dynamic connection ability of Nagahara and employing it into a adaptive neural network.

Nagahara and Mehrotra do not teach a plurality of nanoparticles located within a dielectric solution, wherein said plurality of nanoparticles experiences an alignment with respect to an applied electric field to form a connection network thereof, such that said adaptive physical neural network comprises a plurality of neurons interconnected by a plurality of said nanoconnections; and providing an increased frequency of said applied electric field to strengthen said plurality of

nanoparticles within said adaptive physical neural network regardless of a network topology thereof.

Olson teaches a plurality of nanoparticles located within a dielectric solution, wherein said plurality of nanoparticles experiences an alignment with respect to an applied electric field to form a connection network thereof, such that said adaptive physical neural network comprises a plurality of neurons interconnected by a plurality of said nanoconnections; and providing an increased frequency of said applied electric field to strengthen said plurality of nanoparticles within said adaptive physical neural network regardless of a network topology thereof. (**Olson,** p1:1-15; The neural network of Olson contains a plurality of neurons and nanoconnections.) It would have been obvious to a person having ordinary skill in the art at the time of applicant's invention to modify combined teachings of Nagahara and Mehrotra by using nanotechnology with neural networks as taught by Olson to have a plurality of nanoparticles located within a dielectric solution, wherein said plurality of nanoparticles experiences an alignment with respect to an applied electric field to form a connection network thereof, such that said adaptive physical neural network comprises a plurality of neurons interconnected by a plurality of said nanoconnections; and providing an increased frequency of said applied electric field to strengthen said plurality of nanoparticles within said adaptive physical neural network regardless of a network topology thereof.

For the purpose of combining the details of neural networks and nanotechnology with the product from a startup company LowmTech LLC.

In response to applicants argument.

Regarding claim 9, the Examiner argued that Bezryadin teaches configuring an adaptive physical neural network to comprise a plurality of nanoparticles located within a dielectric solution, wherein said plurality of nanoparticles experiences an alignment with respect to an applied electric field to form a connection network thereof, such that said adaptive physical neural network comprises a plurality of neurons interconnected by a plurality of said nanoconnections. In support of this assertion, the Examiner cited Bezryadin, Page 2, lines 7-17, and provided an EN, arguing that the "physical neural network" of Applicant is equivalent to `1D arrays' of Bezryadin.

The Examiner admitted that Bezryadin and Mehrotra do not teach providing an increased frequency of said applied electric field to strengthen said plurality of nanoparticles within said adaptive physical neural network regardless of a network topology thereof. The Examiner argued, however, that Middleton teaches providing an increased frequency of said applied electric field to strengthen said plurality of nanoparticles within said adaptive physical neural network regardless of a network topology thereof. In support of this assertion, the Examiner cited Middleton, page 3198, C1:21-25.

The Examiner argued that it would have been obvious to a person having ordinary skill in the art at the time of the Applicant's Invention to modify the combined teachings of Bezryadin and Mehrotra to provide for an increase in the electrical field (arguing increased frequency) to improve the conductivity state of the nanoparticles as taught by Middleton to providing an increased frequency of said applied electric field to strengthen said plurality of nanoparticles within said adaptive physical neural network regardless of a network topology thereof. The Examiner argued that the purpose being is to have the ability of charging the output based on the connectivity of the nanoparticles.

The Applicant respectfully disagrees with this assessment. The END that the "physical neural network of applicant is equivalent to 'ID arrays' of Bezryadin is incorrect. As indicated previously, Bezryadin has no physical analog of a neuron or of a synapse, but rather deals exclusively with the formation of a particle, chain that is used as the basis for a guantum_mechani l tra_nspart study dealing with coulomb. blockades. The phvsjcalural netwc of Applicant's Invention, on the other hand, is formed from the assembly of nanoparticies disposed in a solution and attracted to connection gaps formed by pre and post synaptic electrodes, which are connected to neural circuits capable of applying a feedback in the form of a refractory pulse generator. Bezryadin constructs a single chain of nanoparticle to create coulomb blockade. This is not an adaptive synapse, certainly ngt a neuron (a neuron would require current amplification), and in no

way configures a plurality of neurons and synapses to form a physical neural network, nor does Bezryadin imply hint or postulate that this is possible. Middleton does not provide an increased frequency of said applied electric field to strengthen said plurality of nanoparticles within said adaptive physical neural network, nor does Middleton even mention the word "frequency" throughout the entire document. The Middleton study looks at the conductance change of an array of stationary metal dots as a function of voltage at extremely low temperatures in a vacuum. The notion that these nanoparticles change their connectivity during the course of the experiment is false because at no point do the nanoparticles actually move, The Middleton paper, the device that it models and the conclusions that it reaches simply do not have any relevance to an adaptive neural network built from nanoparticles disposed in a liquid, nor can Middleton be combined with any other paper to provide one skilled in the art with an adaptive physical neural network as taught by Applicant's Invention.
As indicated previously Mehrotra does ngt provide for any teaching of a physical neural network, but only provides a teaching of software/algorithmic neural networks, which constitute a much different type of device, Mehrotra also does not provide for any teachings of nanotechnotogy devices and components. Also, as indicated previously, Bezryadin also does nut provide for any teaching of a neural network and/or neural network components. Additionally, Middleton does not provide for any teaching of a neural network, a physical neural network, neural network components and so forth.

Regarding the Applicant's EN that Applicant's "physical neural network" is equivalent to "1D arrays" of Bezryadin, the Applicant notes that the Examiner has not explained how "ID arrays" of Bezryadin constitute a "physical neural network" as taught by Applicant's invention, which is a device constituting a variety of physical neural network components, including neurons, pre and post synaptic electrodes and so forth. The ID array of Bezryadin is just that...simply an array and nothing more. Such an array cannot process information according to neural network principals. The EN asserted by the Examiner is thus improper without further explanation and evidence supporting this assertion. Simply setting forth a statement that the 10 array of Bezryadin is equivalent to a physical neural network as taught by Applicant's invention is improper without further support or elaboration, particularly with respect to how the 1D array of Bezryadin processes information in a neural network manner or how such a 1D array could even be modified to process information in a neural network manner.

Additionally, Bezryadin, Mehrotra, and/or Middleton, either alone or individually, do not teach all of the following claim limitations of Applicant's claim 9: an adaptive physical neural network, neurons, interconnected nanoconnections, and so forth, which are an essential aspect of Applicant's claim 9. Middleton at page 3198, C1:21-25, does not provide for any hint or teaching of such claim limitations. Taken together, Bezryadin, Mehrotra, and/or Middleton simply do not teach all of the claim limitations of Applicant's claim 9, including all of the claim limitations of the claim from which claim 9 depends. The Examiner has not provided any evidence to the contrary.

The Applicant further notes that the Examiner's arguments against claim 9 fail under all three prongs of the aforementioned prima facie obviousness test. Under the first prong of the aforementioned prima facie obviousness test, in order to establish a rejection under 35 U.S.C. 103, the Examiner must provide some suggestion or motivation, either In the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings in order to achieve a of the claim limitations of Applicant's rejected claim(s). In this case, the Examiner has failed to identify some suggestion or motivation in the Bezryadin, Mehrotra, and/or Middleton references for achieving all of the claim limitations of Applicant's dependent claim 9.

Regarding the issue of motivation, the Applicant reminds the Examiner that the language of the references may not taken out of context and combined without motivation, in effect producing the words of the claims (and sometimes, not even the words or concepts of the claims), without their meaning or context. The resultant combination would not yield the invention as claimed. The claims are rejected under 35 U.S.C. §103(a) and no showing has been made to provide the motivation as to why one of skill in the art would be motivated to make such a combination, and further fails to provide the teachings necessary to fill the gaps in these references in order to yield the invention as claimed. The rejection to claim 9 under 35 U.S.C. §103(a) has provided no more motivation than to simply point out the individual words of the Applicant's claims among the references, but without the reason and result as provided in the Applicant's claims and specification, and without reason as to why and how the references could provide the Applicant's invention as claimed. Hindsight cannot be the basis for motivation, which is not sufficient to meet the burden of sustaining a 35 U.S.C. §103(a) rejection.

Regarding the second prong of the aforementioned prima facie obviousness, the Examiner has not provided a "reasonable expectation of success" for modifying Bezryadin as suggested by the Examiner to achieve all of the claim limitations of Applicant's claim 9, particularly where as indicated above, the Bezryadin, Mehrotra, and/or Middleton references do not provide any teaching or hint of a neural network and neural network components. It is not generally enough that the Bezryadin, Mehrotra, and/or Middleton references suggest the combination of claim elements recited in Applicant's claim 9; there must also be some reasonable expectation of success for the suggested combination, See In re Vaeck. 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Regarding the third prong of aforementioned prima fade obviousness test, the Examiner has also IZt identified the teaching or suggestion of a , the claim limitations by the Bezryadin, Mehrotra, and/or Middleton references either individually or when combined with one another. Where do the Bezryadin, Mehrotra, and/or Middleton references provide for a hint of all of the claim

limitations of Applicant's claim 9? Based on the foregoing, the Applicant submits that the rejection to claim 9 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 9.

Examiners response.

New art had been introduced so applicant's arguments are irrelevant.

14. Claim 10.

Mehrotra teaches providing at least one output from at least one neuron of said plurality of neurons to an input of another neuron of said adaptive physical neural network (**Mehrotra**, p122:fig 4.9(a); EN There are 3 input nodes for a single output node.).

In reference to the Applicant's argument:

Regarding claim 10, the Examiner admitted that Bezryadin does not teach providing at least one output from at least one neuron of said plurality of neurons to an input of another neuron of said adaptive physical neural network. The Applicant notes that as indicated above Bezryadin also does not provide for any hint or suggestion of a neural network or a physical neural network and neural network components. The Examiner argued, however, that Mehrotra teaches providing at least one output from at least one neuron of said plurality of neurons to an input of another neuron of said adaptive neural network. In support of this assertion, the Examiner cited Mehrotra, page 122, Fig. 4.9(a) and also provided an EN, arguing that there are three input nodes for a single output node.

The Examiner asserted that it would have been obvious to a person having ordinary skill in the art at the time of the Applicant's invention to modify the teachings of Bezryadin by illustrating a basic design of a neural network of an adaptive design as taught by Mehrotra to have at leas tone output from at least one neuron of said plurality of neurons to an input of another neuron of said adaptive physical neural network. The Examiner argued that the purpose being is to have the ability of charging the design of the neural network based on the given input or situation.

The Applicant respectfully disagrees with this assessment and notes that the arguments present above against the rejection to claim 9 apply equally to the rejection to claim 10.

The Applicant has already demonstrated herein that Bezryadin does not teach a physical neural network, and than the combination of references cited by the Examiner do not present an obvious example of a physical neural network. The notion that the output of a neuron can connect to another neuron is of course not novel. However, the notion that particles can form between the pre- and post-synaptic electrodes of neural node circuits and the connections (plural) can be adapted according to the method of claim 9 is not at all obvious to those skilled in the art. Providing the method of connection adaptation given in claim 9 to multiple connections leads to a unique and revolutionary connection adaptation mechanism such as that taught by Applicant's invention. The goal is not to give the user the ability to change the design of the neural network based on the given input or situation, but to have the connections adapt themselves based on the given input or situation. Connections cannot adapt so as to learn to extract information from a datastream unless multiple connections can interact through a neuron and their connection strengths can be adapted.

The Applicant also previously demonstrated herein that Mehrotra does ri4S provide for any teaching of a physical neural network and instead clearly teaches away from a physical neural network and focuses on algorithmic or software based neural networks. Thus, it is improper to combine Mehrotra with any of the other cited references to argue a teaching of a physical neural network a s taught by Applicant's invention. Based on the foregoing, the Applicant submits that the rejection to claim 10 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 10.

Examiner's response.

Mehrotra illustrates the basic design of an adaptive neural network.

Claim Rejections - 35 USC § 103

15. Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Nagahara, Mehrotra and Olson, as set

forth above, and further in view of Tapang , referred to as **Tapang** (U. S. Patent 4926064)

16. Claim 11.

Nagahara, Mehrotra and Olson do not teach automatically summing at least one signal provided by said connection network via at least one neuron of said adaptive physical neural network to provide a summation value thereof; comparing said summation value to a threshold value and emitting a pulse if a current activation state exceeds said threshold value; and automatically grounding or lowering to -Vcc a post synaptic junction associated with said at least one neuron during emission of said pulse, thereby causing at least one synapse in receipt of a pre-synaptic activation to experience an increase in a local electric field, such that at least one synapse that contributes to an activation of said at least one neuron experiences an increase in said local electric field parallel to a connection direction associated with said connection network and additionally experiences a higher frequency of activation in order to increase a strength of said nanoconnections.

Tapang teaches automatically summing at least one signal provided by said connection network via at least one neuron of said adaptive physical neural network to provide a summation value thereof (**Tapang**, C8:58 through C9:2); comparing said summation value to a threshold value and emitting a pulse if a current activation state exceeds said threshold value (**Tapang**, C10:17-45); and automatically grounding or lowering to -Vcc a post synaptic junction associated

with said at least one neuron during emission of said pulse, thereby causing at least one synapse in receipt of a pre-synaptic activation to experience an increase in a local electric field, such that at least one synapse that contributes to an activation of said at least one neuron experiences an increase in said local electric field parallel to a connection direction associated with said connection network and additionally experiences a higher frequency of activation in order to increase a strength of said nanoconnections (**Tapang**, C10:17-45; EN 'Grounding' of applicant is equivalent to 'pull down toward ground the voltage at its output point' of Tapang.). It would have been obvious to a person having ordinary skill in the art at the time of applicant's invention to modify combined teachings of Nagahara, Mehrotra and Olson by illustrating the physics and design of the summation value with a comparator of the neural network as taught by Tapang to automatically summing at least one signal provided by said connection network via at least one neuron of said adaptive physical neural network to provide a summation value thereof; comparing said summation value to a threshold value and emitting a pulse if a current activation state exceeds said threshold value; and automatically grounding or lowering to -Vcc a post synaptic junction associated with said at least one neuron during emission of said pulse, thereby causing at least one synapse in receipt of a pre-synaptic activation to experience an increase in a local electric field, such that at least one synapse that contributes to an activation of said at least one neuron experiences an increase in said local electric field parallel to a connection direction associated

with said connection network and additionally experiences a higher frequency of activation in order to increase a strength of said nanoconnections.

For the purpose of describing in detail when the total sum of inputs are put into a comparator, and if a amount is higher than the voltage node the pulse is discharged.

In reference to the Applicant's argument:

Regarding claim 11, the Examiner admitted that Bezryadin, Mehrotra and MIddleton do not teach automatically summing at least one signal provided by said connection via at least one neuron of said adaptive physical neural network to provide a summation value thereof; comparing said summation value to a threshold value and emitting a pulse if a current activation state exceeds said threshold value; and automatically grounding or lowering to -Vcc a post synaptic junction associated with said at least one neuron during emission of said pulse, thereby causing at least one synapse in receipt of a pre-synaptic activation to experience an increase In a local electric field, such that at least one synapse that contributes to an activation of said at least one neuron experiences an increase in said local electric parallel field to a connection direction associated with said connection network and additionally experiences a higher frequency of activation in order to increase a strength of said nanoconnections.

The Examiner argued that Tapang teaches automatically summing at least one signal provided by said connection network via at least one neuron of said adaptive physical neural network to provide a summation value thereof (citing Tapang, C8;58 through C9:2); comparing said summation value to a threshold value and emitting a pulse if a current activation state exceeds said threshold value (citing Tapang, 010:17-45); and automatically grounding or lowering to -Vcc a post synaptic junction associated with said at least one neuron during emission of said pulse, thereby causing at least one synapse in receipt of a pre-synaptic activation to experience an increase in a local electric field, such that at least one synapse that contributes to an activation of said at least one neuron experiences an increase in said local electric field parallel to a connection direction associated with said connection network and additionally experiences a higher frequency of activation in order to increase a strength of said nanoconnections. In support of this argument, the Examiner cited Tapang, 010:17-45 and presented an EN arguing "grounding" of Applicant's invention is equivalent to "pull down toward ground the voltage at its output point" of Tapang.

The Examiner argued that it would have been obvious to a person having ordinary skill in the art at the time of the Applicant's invention to modify the combined teachings of Bezryadin, Mehrotra and Middleton by illustrating the

physics and design of the summation value with a comparator of the neural network as taught by Tapang to automatically sum at least one signal provided by the connection network via at least one neuron of the adaptive physical neural network to provide a summation value thereof; comparing said summation value to a threshold value and emitting a pulse if a current activation state exceeds said threshold value; and automatically grounding or lowering to —Vcc a post synaptic junction associated with said at least one neuron during emission of said pulse, thereby causing at least one synapse in receipt of a pre-synaptic activation to experience an increase in a local field, such that at least one synapse that contributes to an activation of said at least one neuron experiences an increase in said local electric field parallel to a connection direction associated with said connection network and additionally experiences a higher frequency of activation in order to increase a strength of said nanoconnections. The Examiner argued "for the purpose of describing in detail when the total sum of inputs are put into a comparator, and if an amount is higher than the voltage node the pulse discharged."

The Applicant respectfully disagrees with this assessment and again notes that the arguments presented above against the rejection to claim 9 apply equally to the rejection to claim 11. The Applicant again notes that that Mehrotra does not provide any teaching or suggestion of a physical neural network based on nanotechnology components, but only relates to "artificial neural networks" that are software based. The Examiner has not explained how Mehrotra suggests or teaches a nanotechnology based physical neural network (as opposed to a software based neural network).

Regarding the Middleton reference, the Applicant notes that Middleton does not provide any teaching or suggestion for any type of neural network and/or neural network components, either software or physical based neural networks. Middleton only relates to collective transport in arrays of small metallic dots, but again does not provide for any hint or suggestion of physical neural networks and/or neural network components.

Regarding the Tapang reference, Tapang does not teach, nor imply the use of nanoparticles as a synapse, which is inherent to claim 11 by its dependence to the method of claim 9. Tapang describes a method for refreshing capacitively stored synaptic weights (first sentence of Tapang). It has been demonstrated that capacitively stored synaptic weights are limited in their ability to form very large and adaptive physical neural systems. The use of nanoparticles as a synapse alleviates this problem. In other words, we are claiming a solution to a problem inherent in the design of Tapang.

It is also significant to note that Tapang provides absolutely no teaching of nanotechnology based components. In fact, the various electrical components taught by the Tapang reference teach away from nanotechnology components and focus instead on much larger electrical components for forming neural connections, such as, for example, the various transistors, amplifiers, and so forth depicted in FIGS. 1-11 of Tapang. These components dearly teach away from nano-sized components. Thus, the Examiner's reference to Tapang is

improper because Tapang clearly teaches away from nanotechnology based components.

Additionally, as indicated earlier Bezryadin provides no teaching for neural network and neural network components. It is therefore improper to combine references as suggested by the Examiner because some of the references completely lack a teaching of a neural network while the others lack a teaching of nanotechnology based components, and still others teach non-physical neural networks such as algorithmic or software based neural networks. The combination of references as suggested by the Examiner for rejecting the Applicant's claims is simply Improper due to this hodgepodge of teachings and lack thereof of the even the most basic aspects of Applicant's invention. Based on the foregoing, the Applicant submits that the rejection to claim 11 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 11.

Examiner's response.

Tapang concepts in conjunction with nanotechnology of Nagahara and Olson with design concepts of Mehrotra now teach a solution that is inherent of a hardwired neural network.

17. Claim 12.

The combination of Nagahara, Mehrotra and Olson do not teach at least one neuron of said physical neural network comprises an integrator.

Tapang teaches at least one neuron of said physical neural network comprises an integrator (**Tapang**, C8:39-57). It would have been obvious to a person having ordinary skill in the art at the time of applicant's invention to modify combined teachings of Nagahara, Mehrotra and Olson by having a device which fires a response within certain parameters as taught by Tapang to have at least one neuron of said physical neural network comprises an integrator.

For the purpose of having the neuron fire under a pre-synaptic condition of when neuron's excitation level is greater then the neuron's threshold value.

In reference to the Applicant's argument:

Regarding claim 12, the admitted that the combination of Bezryadin, Mehrotra, and Middleton do not teach that at least one neuron of said physical neural network comprises an integrator. The Examiner argued that Tapang teaches at least one neuron of said physical neural network comprising an integrator (citing Tapang, C8:39-57). The Examiner asserted that it would have been obvious to a person having ordinary skill in the art at the time of Applicant's invention to modify the combined teachings of Bezryadin, Mehrotra and Middleton by having a device that fires a response within certain parameters as taught by Tapang to have at least one neuron of said physical neural network comprising an integrator. The Examiner argued that "for the purpose of having the neuron fire a pre-synaptic condition of when neuron's excitation level is greater than the neuron's threshold value."

The Applicant respectfully disagrees with this assessment and submits that the arguments presented above against the rejection to claims 1-11 apply equally to the rejection to claim 12. The arguments presented above against the Tapang reference, for example, apply equally here to claim 11. Tapang does not teach, nor does imply the use of nanoparticles as a synapse, which is inherent in claim 12 by its reference to the method of claim 9.

Tapang teaches away from nanotechnology based components due to the large size of its device components. That is, the device of Tapang could not be modified to function in a nanotechnology environment because there is absolutely no teaching of nano-components and nano-devices in Tapang, which simply lacks any teaching of nanotechnology. As indicated previously, Bezryadin does not provide for any teaching of a neural network or neural network components, while Mehrotra teaches away from physical neural networks and focuses on algorithmic or software based neural networks and provides absolutely no teaching or hint of a nanotechnology based neural network. Additionally, Middleton does not provide any teaching or suggestion for anx type of neural network and/or neural network components, either software or physical based neural networks. Middleton only relates to collective transport in arrays of small metallic dots, but again does not provide for any hint or suggestion of .ahysical neural networks and/or neural network components. It is therefore improper to combine the references as suggested by the Examiner to teach all of the claim limitations of Applicant's claim 12 and any claims dependent upon claim 12.

The Applicant asks, where do Bezryadin, Mehrotra, Middleton and Tapang teach each and every claim limitation of Applicant's claim 12? The Examiner has not provided any evidence to the contrary. Based on the foregoing, the Applicant

submits that the rejection to claim 12 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 12.

Examiner's response.

Tapang concepts in conjunction with nanotechnology of Nagahara and Olson with design concepts of Mehrotra now teach a solution that is inherent of a hardwired neural network.

Claim Rejections - 35 USC § 103

18. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> Claims 13, 15, 16, 17, 21, 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Olson in view of Mehrotra ('Startup combines nanotechnology with neural nets': referred to as **Olson**; 'Elements of Artificial Neural networks', referred to as **Mehrotra**).

19. Claim 13.

Olson teaches providing a physical neural network comprising a plurality of neurons connected via a plurality of nanoconductors disposed within a dielectric solution to form at least one connection network of nanoconnections thereof, wherein said nanoconnections transfer signals. (**Olson,** 1-15; Olson illustrates an neural network composed of nanotechnology resulting in nanoconnections which in turn transfer signals.) It would have been obvious to a

person having ordinary skill in the art at the time of applicant's invention to modify combined teachings of Nagahara and Mehrotra by using nanotechnology in the form of neural networks as taught by Olson physical neural network until said at least one output changes to a desired output.

Mehrotra teaches presenting an input data set to said physical neural network to produce at least one output thereof; and increasing network activity within said physical neural network until said at least one output changes to a desired output (**Mehrotra**, p122:fig 4.9(a); EN There are 3 input nodes for a single output node.). It would have been obvious to a person having ordinary skill in the art at the time of applicant's invention to modify teachings of Nagahara by illustrating the basic design of a neural network as taught by Mehrotra to present an input data set to said physical neural network to produce at least one output thereof; and increasing network activity within said physical neural network until said at least one output changes to a desired output.

The purpose being to take advantage of dynamic connections ability to generate an adaptive neural network.

In reference to applicants argument.

Regarding claim 13, the Examiner argued that Bezryadin, teaches providing a physical neural network comprising a plurality of neurons to provide a physical neural network comprising a plurality of neurons connected via a plurality of nanoconductors disposed within a dielectric solution to form at least one connection network of nanoconnections thereof, wherein said nanoconnections transfer signals.

For the purpose of having dynamic connections that lend itself to an adaptive neural network.

Nagahara does not teach presenting an input data set to said physical neural network to produce at least one output thereof; and increasing network activity

within said connected via a plurality of nanoconductors disposed within a dielectric solution to form at least one connection network of nanoconnections thereof, wherein said nanoconnections transfer signals. In support of this argument, the Examiner cited Bezryadin, Page 2: 7-19 and provided an EN, arguing that the "neural network" of Applicant's invention is equivalent to "arrays" of Bezryadin.

The Examiner admitted that Bezryadin does not teach presenting an input data set to said physical neural network to produce at least one output thereof; and increasing network activity within said physical neural network until said at least one output changes to a desired output. The Examiner argued, however, that Mehrotra teaches presenting an input data set to said physical neural network to produce at least one output thereof; and increasing network activity within said physical neural network until said at least one output changes to a desired output. In support of this argument, the Examiner cited Mehrotra, page 122; fig 4.9(a) and provided an EN arguing that there are three input nodes for a single output node. The Examiner argued that it would have been obvious to a person having ordinary skill in the art at the time of the Applicant's invention to modify the teachings of Bezryadin to present an input data set to said physical neural network to produce at least on output thereof; and increasing network activity within said physical neural network until said at leas tone output changes to a desired output. The Examiner argued that "the purpose being to take advantage of the strengths of a neural network design."

The Applicant respectfully disagrees with this assessment and notes that arguments presented above with respect to claims 1-12 apply equally to the rejection to claim 13. The Applicant submits that neither Bezryadin, Mehrotra, Middleton and/or Tapang teach jj of the following claim limitations of claim 13: A method for training a physical neural. network formed utilizing ngnotechpologv, said method comprising the steps of: providing a physical neural network comprising a plurality of neurons connected via a plurality of najiocooductors disposed within a dielectric sotutign, to form at least one connection network of nanoconnections thereof, wherein said nanoconnections transfer signal; presenting an input data set to said Musical neural _network to produce at least one output thereof; and increasing network activity within said physical neural network until said at least one output changel to a desired output. The Examiner has not provided any evidence to the contrary for a teaching of a physical neural network based on nanotechnology among the Bezryadin, Mehrotra, and/or Middleton references. Tapang teaches away from nano-scale devices, and thus it is improper to combine Tapang with another reference that teaches nanoscale devices, since to do so would render any rejections thereof improper. The Examiner cited Bezryadin, Page 2: 7-19 and provided an EN, arguing that the "neural network" of Applicant's invention is equivalent to "arrays" of Bezryadin.

The Applicant notes that Bezryadin, Page 2: 7-19 refers only to "arrays composed of nanometer scale metallic particles synthesized chemically" and that "new approaches should be developed in order to organize such nanoparticles into useful electronic devices. The Applicant asks, how does "array" teach a "neural network" as taught by Applicant's invention? The Examiner has made a statement that the "neural network" of Applicant's invention is equivalent to "arrays" but has provided D,Q evidence and explanation of how and why this is so. Bezryadin, Page 2: 7-19 does not provide even a hint or suggestion for a complicated device such as a neural network.

Regarding the Examiner's citation of Mehrotra, page 122; fig 4.9(a) and the EN arguing that there are three input nodes for a single output node, the Applicant submits that Mehrotra is improper to cite as a basis for teaching a 'physical neural network" because as indicated previously, Mehrotra provides absolutely no teaching for a physical neural network, and instead is directed toward algorithmic/software artificial neural networks, which as explained in Applicant's background section of Applicant's specification, are essentially slow and awkward, and plagued with problems. A hardware implantation of a neural network based on nanotechnology is not a mere trivial advancement over the Bezryadin, Mehrotra, Middleton and/or Tapang references, but represents a revolutionary advancement over such references. The citation of Mehrotra, page 122; fig 4.9(a) as a basis for rejecting Applicant's claim 13 is improper in light of the fact that Mehrotra provides absolutely no teaching for a physical neural network and nano-scale devices. In fact, Mehrotra teaches away from physical neural networks by its limitation to algorithmic/software implementations.
As indicated previously, Bezryadin has no physical analog of a neuron or of a synapse, but deals exclusively with the formation of a particle chain that is used as the basis for a low temperature quantum mechanical transport study dealing with coulomb blockades.

Mehrotra, p122 fig 4.9(a) and (b) does not teach Increasing network activity but rather increases the number of nodes in a network. As previous explained, it is impossible to increase the number of nodes in a physical neural network as this would be equivalent to transistors spontaneously appearing on a chip. Increasing the number of neurons in a network has no correlation with increasing network activity. For example, increasing the number on inhibitory neurons, or alternately the number of neurons with negative connections, could actually decrease the network activity.

The Applicant further notes that the Examiner's arguments with respect to claim 13 fail under all three prongs of the aforementioned prima facie obviousness test. Under the first prong of the aforementioned prima fade obviousness test, in order to establish a rejection under 35 U.S.C. 103, the Examiner must provide some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings in order to achieve a of the claim limitations of

Applicant's rejected claim(s). In this case, the Examiner has failed to identify some suggestion or motivation in all of the Bezryadin, Mehrotra, Middleton and/or Tapang references reference for achieving 11 of the claim limitations of Applicant's amended claim 13.

Regarding the issue of motivation, the Applicant reminds the Examiner that the language of the references may not taken out of context and combined without motivation, in effect producing the words of the claims (and sometimes, not even the words or concepts of the claims), without their meaning or context. The resultant combination would not yield the invention as claimed. The claims are rejected under 35 U.S.C. §103(a) and no showing has been made to provide the motivation as to why one of skill in the art would be motivated to make such a combination, and further fails to provide the teachings necessary to fill the gaps in these references in order to yield the invention as claimed. The rejection to claim 13 under 35 U.S.C. §103(a) has provided no more motivation than to simply point out the individual words of the Applicant's claims among the references, but without the reason and result as provided in the Applicant's claims and specification, and without reason as to why and how the references could provide the Applicant's invention as claimed. Hindsight cannot be the basis for motivation, which is not sufficient to meet the burden of sustaining a 35 U.S.C. §103(a) rejection.

Regarding the second prong of the aforementioned prima fade obviousness, the Examiner has not provided a "reasonable expectation of success" for combining the Bezryadin, Mehrotra, Middleton and/or Tapang references as suggested by the Examiner to achieve All of the claim limitations of Applicant's claim 13. It is not generally enough that the Bezryadin, Mehrotra, Middleton and/or Tapang references suggest the combination of claim elements recited In Applicant's claim 13; there must also be some reasonable expectation of success for the suggested combination, See L I M Y eck. 9_47 F.2d 488. 20 U_SPQ2d 1438 ('Fed. Cit,_1.991).

Regarding the third prong of aforementioned prima facie obviousness test, the Examiner has also not identified the teaching or suggestion of eat_. and every elernent and feature of Applicant's claim 13 by the Bezryadin, Mehrotra, Middleton and/or Tapang references. Where does the Bezryadin reference provide for a teaching of a of the claim limitations of Applicant's claim 13? Based on the foregoing, the Applicant submits that the rejection to claim 13 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 13.

Examiners response.

New art had been introduced so applicant's arguments are irrelevant.

20. Claim 15.

Olson teaches plurality of neurons comprises a plurality of interconnected neurons that are interconnected by said nanoconnections, each of said nanoconnections being associated with a weight; and said increasing said network activity within said physical neural network includes scaling a weight associated with said nanoconnections by a positive factor. (**Olson,** 1-15; 'Weight' of applicant is equivalent to 'strenghten or weaken connections' of Olson. 'Positive factor' of applicant is equivalent to 'electrical fields' and their effect on nanoparticles.)

In response to applicants arguments.

Regarding claim 15, the Examiner admitted that the combination of Bezryadin and Mehrotra do not teach said plurality of neurons comprises a plurality of interconnected neurons that are interconnected by said nanoconnections, each of said nanoconnections being associated , with a weight; and said increasing said network activity within said physical neural network includes scaling a weight associated with said nanoconnections by a positive factor. The Examiner argued, however, that Middleton teaches said plurality of neurons comprising a plurality of interconnected neurons that are interconnected by said nanoconnections, each of said nanoconnections being associated with a weight. In support of this assertion,

the Examiner cited Middleton, page 3199, C1:6-10, and provided an EN arguing that the "weight" of Applicant's invention is equivalent to "voltage" by Middleton. The Examiner further argued that Middleton teaches said increasing said network activity within said physical neural network includes scaling a weight associated with said nanoconnections by a positive factor. In support of this assertion, the Examiner cited Middleton, page 3198, C1:21-25.

The Examiner argued that it would have been obvious to a person having ordinary skill in the art at the time of the Applicant's invention to modify the combined teachings of Bezryadin and Mehrotra by using voltage instead of a numerical value for weight as taught by Middleton to have said plurality of neurons comprising a plurality of interconnected neurons that are interconnected by said nanoconnections, each of said nanoconnections being associated with a weight; and said increasing said network activity within said physical neural network includes scaling a weight associated with said nanoconnections by a

positive factor. The Examiner asserted that since the nanoparticles and nanoconnections are the basis of the invention and voltage conductivity can be altered by the amount of electricity which passes through, having voltage as a form of weight falls into the basic properties of the invention.

The Applicant respectfully disagrees with this assessment and notes that the arguments presented above against the rejection to claim 13 apply equally against the rejection to claim 15. Again, the Applicant notes that Middleton provides absolutely no teaching for a neural network and/or neural network components (e.g., neurons). The Examiner's argument that Middleton teaches said plurality of neurons comprising a plurality of interconnected neurons that are interconnected by said nanoconnections, each of said nanoconnections being associated with a weight, is flawed because Middleton does not teach a "neuron". The Examiner's citation of page 3199, C1:6-10 fails to mention any type of neural network or neural network components such as neurons. Additionally, the Examiner has not explained how and why the "weight" of Applicant's invention is equivalent to the "voltage" of Middleton in light of the fact that Middleton offers absolutely no teaching for a neural network and/or a neuron.

The Examiner's argument that Middleton teaches said increasing said network activity within said physical neural network includes scaling a weight associated with said nanoconnections by a positive factor is also flawed. The Examiner cited Middleton, page 3198, C1:21-25, but did not identify which sections of this citation specifically teach a neural network, a physical neural network, or neural network activity. As such, without a teaching for these claim limitations, Middleton cannot properly be utilized as a basis for rejecting claim 15.

The examiner has claimed that the `weight' of Applicant's invention is equivalent to 'voltage' by Middleton. It is again important to note that the Middleton paper is a computational study of a 2 dimensional lattice of small normal-metal dots separated by tunnel barriers at low temperatures. This experimental setup bares no similarity to the physical system as described in Applicant's patent application, The 'weight' of Applicant's invention is the conductance (or resistance) of an aggregation of particles in a liquid due to a dipole-induced force caused by a field Inhomogenety at electrode gaps. Applicant's "weight" is thus a physical property of a group of nanoparticles and is not in any way represented by a voltage. By claiming that the 'weight' of the applicant Is equivalent to `voltage' by Middleton, the Examiner is stating that resistance Is equal to voltage, which of course is wrong from the most basic electronic standpoint. The voltage, as referenced by the examiner in Middleton, P 3199 Cl: 21-25, is the voltage on a single conducting quantum dot in an ordered array as found by summing over the capacitance and voltages of the other dots in the ordered array. The 'weight', as described by this patent application, is the dipole-induced aggregation of nanoparticles in a liquid across an electrode gap and the resulting resistance formed by this aggregation while still in the liquid. Based on the foregoing, the

Applicant submits that the rejection to claim 15 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 15.

Examiners response.

New art had been introduced so applicant's arguments are irrelevant.

21. Claim 16.

Olson teaches plurality of neurons comprises a plurality of interconnected neurons that are interconnected by nanconnections for transferring signals having a magnitude in a firing state (**Olson,** 1-15; Neural networks that are composed on nanotechnology are comprise of interconnecting neurons and nanoconnections. 'Magnitude' of applicant is equivalent to 'strenghten or weaken' of Olson.); and said increasing said network activity within said physical neural network includes increasing said magnitude of said signal in said firing state. (**Olson,** 'Increasing said magnitude' of applicant is equivalent to 'increasing electrical field' of Olson. Resulting in increased signal of applicant or strengthen connections of Olson.)

In reference to applicants arguments.

Regarding claim 16, the Examiner admitted that the combination of Bezryadin and Mehrotra do not teach said plurality of neurons comprises a plurality of interconnected neurons that are interconnected by nanoconnections for transferring signals having a magnitude in a firing state; and said increasing said network activity within said physical neural network includes increasing said magnitude of said signal in said firing state, The Examiner argued, however, that Middleton teaches said plurality of neurons comprises a plurality of interconnected neurons that are interconnected by nanoconnections for transferring signals having a magnitude in a firing state; and said increasing said network activity within said physical neural network includes increasing said magnitude of said signal in said firing state, The Examiner cited Middleton, page 3198, C1:13-34 and page 3199, C1:6-10 and provided an EN arguing that

"nanoconnections" of Applicant's invention is achieved by "small metallic dots" of Middleton.

The Examiner argued that it would have been obvious to a person having ordinary skill in the art at the time of Applicant's invention to modify the combined teaching of Bezryadin and Mehrotra by going into some detail about the physics of the systems of small metallic parts as taught by Middleton to have a plurality of neurons comprising a plurality of interconnected neurons that are interconnected by nanoconnections for transferring signals having a magnitude in a firing state, and said increasing said network activity within said physical neural network includes increasing said magnitude of said signal in said firing state. The Examiner stated that "for the purpose of having a working physical model wherein its properties can be made to construct a neural network".
The Applicant respectfully disagrees with this assessment and submits that the arguments presented above against the rejection to claim 13 apply equally to the rejection to claim 16. The Examiner's argument that Middleton teaches said plurality of neurons comprises a plurality of interconnected neurons that are interconnected by nanoconnections for transferring signals having a magnitude in a firing state; and said increasing said network activity within said physical neural network includes increasing said magnitude of said signal in said firing state, is Improper because Middleton does not teach neurons, interconnected neurons, a firing state, a magnitude in a firing state, neural network activity, a physical neural network, increasing the magnitude, and all of the other claim limitations of Applicant's claim 16. The Examiner citation of Middleton, page 3198, 01:13-34 and page 3199, C1:6-10 provides absolutely no teaching of a neuron or a physical neural network. The EN arguing that "nanoconnections" of Applicant's invention is achieved by "small metallic dots" of Middleton is also flawed because the nanoconnections of Applicant's invention represent nanoconnections of a physical (hardware) neural network implementation, while the "small metallic dots" of Middleton provide no teaching for nanoconnections used in a physical neural network.

The examiner is attempting to compare 'nanoconnection' of Applicant's invention to `small metallic dots' of Middleton. One of the fundamental aspects of Applicant's patent application is the assembly and adaptive control of the physical aggregation of nanoparticies in a liquid suspension. In other words, the nanoparticies must be in a liquid and they must physically move so as to adaptively form and break connections. The comparison of this adaptive nanoconnection to a permanently bound ordered array of quantum dots on the surface of a chip is completely wrong and in fact the comparison removes the aspect of the invention that makes it useful as an adaptive connection, i.e. the ability of nanoparticles to physically move. To make this comparison is to state that a moving particle is the same as a stationary particle, which is simply incorrect.

Based on the foregoing, the Applicant submits that the rejection to claim 16 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 16.

Examiners response.

New art had been introduced so applicant's arguments are irrelevant.

22. Claim 17.

Olson teaches said plurality of neurons comprises a plurality of interconnected neurons that are interconnected by a plurality of data input neurons thereof adapted to receive respective external signals (**Olson,** 1-15; 'Neurons' and 'interconnected neurons' of applicant is equivalent to 'neural network' of Olson.); said increasing said network activity within said physical neural network includes increasing a magnitude of said respective external signals. (**Olson,** 1-15; 'Increasing a magnitude of said respective external signals' of applicant is equivalent to increasing electrical fields of Olson.)

In response to applicants argument.

Regarding claim 17, the Examiner admitted that the combination of Bezryadin and Mehrotra do not teach said plurality of neurons comprises a plurality of interconnected neurons that are interconnected by a plurality of data input neurons thereof adapted to receive respective external signals; and said increasing said network activity within said physical neural network includes increasing a magnitude of said respective external signals. The Examiner argued, however, that Middleton teaches said plurality of neurons comprising a plurality of interconnected neurons that are interconnected by a plurality of data input neurons thereof adapted to receive respective external signals; and said increasing said network activity within said physical neural network includes increasing a magnitude of said respective external signals. In support of this assertion, the Examiner cited Middleton, page 3198, C1:13-34 and C2:22-24 and page 3199, Cl 6-10.

The Examiner argued that it would have been obvious to a person having ordinary skill in the art at the time of Applicant's invention to modify the combined teachings of Bezryadin and Mehrotra by illustrating the fact the system has access to external signals as taught by Middleton to have a plurality of neurons comprising a plurality of interconnected neurons that are interconnected by a plurality of data input neurons thereof adapted to receive respective external signals; and increasing said network activity within said physical neural network includes increasing a magnitude of said respective external signals. The Examiner stated "the purpose of having external inputs is so that a user can take advantage of such an invention."

The Applicant respectfully disagrees with this assessment and submits that the arguments presented above against the rejection to claim 13 apply equally to the rejection to claim 17. The Examiner is attempting to claim that the Middleton paper has relevance to neural networks and data input neurons that are adapted to receive external signals. The examiner has referenced the following:

(page 3198 C2:13-34 of Middleton)
"In this Letter we examine the low-temperature, non-linear charge transport in such an array. The dots are treated as capacitively coupled conductors with charged allowed to tunnel between neighboring dots..

and...(page 3198 C2:22-24 of Middleton)
this reference does not exist, as there are only 11 lines in the second column

and (page 3199 C1:6-10 of Middleton)

"the voltage V on dot I due to the leads L,R and the gate g is..."

Middleton does not describe a synapse, a moron, or a neural network. Middleton does not teach any device that processes information, but rather is physically modeling the collective conductance properties of an ordered array of quantum dots. The Examiner is attempting to ascribe a similarity between a 'network' of two dimensional ordered quantum dots cooled to 200 degrees below zero and permanently bound to a chip surface under a vacuum with a physical neural network formed by the dipole induced aggregation of nanoparticles in a liquid solution between pre- and post-synaptic electrodes which are receiving electronic feedback from dedicated neural circuitry. The comparison between Applicant's invention and Middleton is most certainly not obvious because such a comparison simply does not make sense.

The Examiner's citation of Middleton, page 3198, C1:13-34 and C2:22-24 and page 3199, CI 6-10 in support of the argument that Middleton teaches said plurality of neurons comprising a plurality of interconnected neurons that are interconnected by a plurality of data input neurons thereof adapted to receive respective external signals; and said increasing said network activity within said

physical neural network includes increasing a magnitude of said respective external signals, is improper because Middleton, page 3198, C1:13-34 and C2:22-24 and page 3199, Cl 6-10 does not provide grix teaching whatsoever of a neuron, a plurality of neurons, data ino eurons, neural network activity, and a physical neural net= r . Middleton, page 3198, C1:13-34 and C2:22-24 and page 3199, Cl 6-10 instead focuses on arrays of small metallic dots, which do not provide any support for any hint or suggestion of a neural network devices and neural network components such as neuron. Without such a teaching, the Examiner's argument is flawed and cannot be properly utilized as a basis for the rejection under 35 U.S.C. 103. Based on the foregoing, the Applicant submits that the rejection to claim 17 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 17.

Examiners response.

New art had been introduced so applicant's arguments are irrelevant.

23. Claim 21.

Olson does not teach providing said desired output data; and comparing said desired output data and said output to generate said signal in response if said desired output data is not equal to said output.

Mehrotra teaches providing said desired output data (**Mehrotra,** p116:1-6; 'Desired output data' of applicant is equivalent ton 'training samples are needed' of Mehrotra.); and comparing said desired output data and said output to generate said signal in response if said desired output data is not equal to said output. (**Mehrotra,** p118:23-34; Using comparing symbols like 'less than' or 'subset' is one way to compare output data with desired output.) It would have been obvious to a person having ordinary skill in the art at the time of applicant's invention to modify the teachings of Olson by introducing training data for the neural nework as taught by Mehrotra to provide said desired output data; and

comparing said desired output data and said output to generate said signal in response if said desired output data is not equal to said output.

For the purpose of providing the ability of the neural network to learn new functions or situations.

In reference to applicants arguments.

Regarding claim 21, the Examiner admitted that Bezryadin does not teach providing said desired output data; and comparing said desired output data and said output to generate said signal in response if said desired output data is not equal to said output. The Examiner argued, however, that Mehrotra teaches providing said desired output data. In support of this argument, the Examiner cited Mehrotra, pg. 117:3-4 and provided an EN arguing that "desired" is a level of tolerance which is set at an acceptable level. The Examiner argued that Mehrotra also teaches comparing said desired output data and said output to generate said signal in response if said desired output data is not equal to said output. In support of this argument, the Examiner cited Mehrotra, p. 117, lines 2-7 and provided an EN arguing that here Mehrotra illustrates a loop where output data is compared to the desired output data.

The Examiner argued that it would have been obvious to a person having ordinary skill in the art at the time of the Applicant's invention to modify the teachings of Nugent by having the neural network be an adaptive neural network as taught by Mehrotra to have desired output data; and comparing said desired output data and said output to generate said signal in response if said desired output data is not equal to said output. The Examiner stated that "for the purpose of having a network that isn't too large and inefficient to handle a specific task."

The Applicant respectfully disagrees with this assessment and submits that the arguments presented above against the rejection to claim 13 apply equally to the rejection to claim 21. The Examiner's argument that that Mehrotra teaches providing said desired output data is flawed because Mehrotra provides absolutely no teaching or support for a physical neural network (i.e., hardware implementation), but instead only focuses on algorithmic/software neural networks a much different and very slow and cumbersome way of implementing neural networks. The Applicant's "background" section of the specification provides material explaining the inherent problems with such software-based, neural networks. Mehrotra additionally does nQt provide any teaching or suggestion of a nanotechnology based physical neural network nor of a solution in which neural network connections are formed. The Examiner's citation of Mehrotra, pg. 117:3-4 an EN arguing that "desired" is a level of tolerance which is set at an acceptable level, fail to take into account a physical neural network implementation. Additionally, Mehrotra, p. 117, lines 2-7 and the EN arguing that

here Mehrotra illustrates a loop where output data is compared to the desired output data, are also improper given the fact that Mehrotra falls to teach a physical neural network and nanotechnology.

The Examiner is asserting that Mehrotra teaches providing said desired output data and references p117:3-4. This passage describes an algorithm:
Line 3: Find a node of connection whose removal does not penalize
Line 4: performance beyond desirable tolerance levels;
Line 5: Delete this node or connection:

The Examiner argues that 'desired' is a level of tolerance which is set to an acceptable level. This algorithm assumes that one can "find a node and a connection whose removal does not penalize performance" and to "delete this node or connection. The adaptive network as described by Applicant's invention i a physical network. As such, the notion of "finding a node whose removal does not penalize performance" and "deleting a node or connection" does not physically make sense. In other words, the concept of "deleting" is not a physical concept and to imply such would be to violate the conservation of matter and energy. Claim 21 refers to the generation of a signal if a desired output and the network output is not equal, which is referenced to the method of claim 20 which in turn is referenced to the method of claim 13 which describes a physical neural network.

Based on the foregoing, the Applicant submits that the rejection to claim 21 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 21.

Examiners response.

Applicant arguments are based on the existence of a 'physical' and nanotechnology based neural network. If Mehrotra's neural network runs on a computer then it is 'physical' due to the fact the computer is 'physical'. Mehrotra never claims to be based on nanotechnology, but Olson is. Mehrotra is used to illustrate the design of a adaptive neural network.

24. Claim 22.

Olson teaches the physical neural network comprises an adaptive neural network. (**Olson,** 1-15)

In response to applicants arguments

Regarding claim 22, the Applicant notes that the Examiner did not present any arguments in support of a rejection to claim 22. As such, because the Examiner was silent regarding claim 22, claim 22 should be presumed to be allowable. Recall that claim 22, which is dependent upon claim 13, indicates that the physical neural network comprises an adaptive neural network.

Thus, claims 1-22 of the present invention are not taught or suggested by Bezryadin, Mehrotra, Middleton and/or Tapang. Combining these references fails to teach or yield the invention as claimed. The combination of these references fails to teach or suggest all the elements of the claims. Further, one of skill in the art would not be motivated to make such a combination. Therefore, the present invention Is not obvious in light of any combination of Bezryadin, Mehrotra, Middleton and/or Tapang. Withdrawal of the §103(a) rejection to claims 1-22 is therefore respectfully requested.

Examiners response.

New art had been introduced so applicant's arguments are irrelevant.

Claim Rejections - 35 USC § 103

25. Claims 14, 18, 19, 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Olson and Mehrotra, as set forth above, in view of Nagahara. ('Directed placement of suspended carbon nanotubes for nanoscale assembly', referred to as **Nagahara**)

26. Claim 14.

Olson and Mehrotra do not teach increasing said network activity within said physical neural network, further comprises the step of increasing a number of firing neurons in said physical neural network.

Nagahara teaches increasing said network activity within said physical neural network, further comprises the step of increasing a number of firing neurons in said physical neural network. (**Nagahara,** p3826, C1:20 through C2:8; 'Increase of network activity' of applicant is equivalent to 'placement yield' of Nagahara. 'Increasing the number of firings' of applicant is equivalent to 'applying a dc bias' of Nagahara.) It would have been obvious to a person having ordinary skill in the art at the time of applicant's invention to modify combined teachings of Olson and Mehrotra by making a direct correlation between the number of firing neurons and 'network activity' as taught by Nagahara to illustrate increasing said network activity within said physical neural network, further comprises the step of increasing a number of firing neurons in said physical neural network.

For the purpose of illustrating a direct correlation between firing neurons and 'network activity'.

In response to applicants arguments.

Regarding claim 14, the Examiner admitted that the combination of Bezryadin and Mehrotra do not teach the step of increasing a number of firing neurons in said physical neural network. The Examiner argued, however, that Middleton teaches the step of increasing said network activity within said physical neural network, further comprises the step of: increasing a number of firing neurons in said physical neural network. In support of this assertion, the Examiner cited Middleton, Page 3198, C1:21-25 and provided an EN arguing that "increasing said network activity" of Applicant's invention is equivalent to "increasing electrical field" of Middleton. The Examiner asserted that it would have been obvious to a person having ordinary skill in the art at the time of the Applicant's invention to modify the teachings of Bezryadin and Mehrotra by demonstrating how an increase in electrical fields, increases conductivity (arguing "network

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activity") as taught by Middleton to have the step of increasing said network activity within said physical neural network, further comprises the step of: increasing a number of firing neurons in said physical neural network. The Examiner stated that "for the purpose of easily increasing conductivity for future use in the designs of a neural network".

The Applicant respectfully disagrees with this assessment. The Applicant submits that the arguments presented above against the rejection to claim 13 apply equally to the rejection to claim 14. The Examiner has asserted that the `increasing said network activity' of Applicant's invention is equivalent to `increasing electrical field' of Middleton, page 3198, C1:21-25, which reads:

"We find that the onset of conduction occurs at a voltage Vt proportional to the linear array size, This sharp onset is to be contrasted with conduction in one-and two-dimensional disordered material, where an increasing electric field leads to a smooth increase in conductivity."

In other words, Middleton explains how an ordered array of quantum dots leads to non-linear conductance with a threshold voltage that is proportional to the array size, as contrasted with unordered materials like a more typical ohmic resistor.

First it should be noted that the Middleton paper is a computational study of a 2 dimensional lattice of small normal-metal dots separated by tunnel barriers at low temperatures. This experimental setup bares no similarity to the physical system as described in Applicant's patent application. Increasing an electrical field does not have any correlation with an increased neural network activity. Decreasing an electric field by reducing the power supply voltage could have a beneficial effect on network power consumption, but it says absolutely nothing about neural network Activity.

Middleton simply does not describe a synapse, a neuron, or a mural networkk. The examiner is attempting to ascribe a similarity between a 'network' of two dimensional ordered quantum dots cooled to 200 degrees below zero and permanently bound to a chip surface under a vacuum with a physical neural network formed by the dipole induced aggregation of nanoparticles in a liquid solution between pre- and post-synaptic electrodes on the surface of a chip which are receiving electronic feedback from dedicated neural circuitry. The comparison between the disclosed invention and Middleton is most certainly not obvious because it simply does not make sense.

Middleton provides absolutely no teaching of a neural network, let alone a physical neural network. Additionally, Middleton provides absolutely no teaching for neural network components, such as, for example, a neuron. Claim 14 is specifically directed toward increasing a number of firing neurons in said physical neural network. Since Middleton does not provide for any teaching of neurons,

the citation of Middleton, Page 3198, C1:21-25 is Irrelevant. Regarding the EN that "increasing said network activity" of Applicant's invention is equivalent to "increasing electrical field" of Middleton, this statement is flawed because Middleton does not teach or suggest a neural network. The "network activity" of Applicant's invention relates to neural network activity, whereas the "increasing electrical field" of Middleton does not. Based on the foregoing, the Applicant submits that the rejection to claim 14 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 14.

Examiners response.

New art had been introduced so applicant's arguments are irrelevant.

27. Claim 18.

Mehrotra and Olson do not teach said plurality of neurons comprises a plurality of interconnected neurons, each of said interconnected neurons being configured to fire when a corresponding excitation level thereof is greater than or equal to a threshold; and said increasing said network activity within said physical neural network includes lowering said threshold.

Nagahara teaches said plurality of neurons comprises a plurality of interconnected neurons, each of said interconnected neurons being configured to fire when a corresponding excitation level thereof is greater than or equal to a threshold (**Nagahara,** p3827, C1:26-36; 'Excitation level' of applicant is equivalent to 'above 1 MH' of Nagahara.); and said increasing said network activity within said physical neural network includes lowering said threshold. (**Nagahara,** p3826, C2:6-8; 'Increase network activity' and 'lower threshold' of applicant is equivalent to 'choice of frequency' and 'dramatically enhances' of Nagahara.) It would have been obvious to a person having ordinary skill in the art

at the time of applicant's invention to modify combined teachings of Mehrotra and Olson by illustrating by using the correct frequency will enhance encourage the placement of nanoparticles between the electrones as taught by Nagahara to have plurality of neurons comprises a plurality of interconnected neurons, each of said interconnected neurons being configured to fire when a corresponding excitation level thereof is greater than or equal to a threshold; and said increasing said network activity within said physical neural network includes lowering said threshold.

For the purpose of using electrical fields to generate connections between electrodes and using the fact that until a given level of electrical field is applied a connection will not be formed can be seen as a threshold.

In response of applicant argument.

Regarding claim 18, the Examiner admitted that the combination of Bezryadin, Mehrotra and Middleton does not teach aid plurality of neurons comprises a plurality of interconnected neurons, each of said interconnected neurons being configured to fire when a corresponding excitation level thereof is greater than or equal to a threshold; and said Increasing said network activity within said physical neural network includes lowering said threshold. The Examiner argued, however, that Tapang teaches said plurality of neurons comprises a plurality of interconnected neurons, each of said interconnected neurons being configured to fire when a corresponding excitation level thereof is greater than or equal to a threshold; and said increasing said network activity within said physical neural network includes lowering said threshold. In support of this assertion, the Examiner cited Tapang, C10:17-45 and C11:11-37. The Examiner also submitted an EN arguing that Tapang illustrates the mechanics of what happens in regards to the threshold limit and increased voltages leading to the firing of the neuron. The Examiner's EN argued that if all parameters were to remain constant with the exception of the threshold being lowered, then it is easy to see the neuron would fire earlier. The Examiner stated "resulting in the network activity Increasing".

The Examiner argued that it would have been obvious to a person having ordinary skill in the art at the time of Applicant's invention to modify the combined teachings of Bezryadin, Mehrotra, and Middleton by explaining if the threshold was lowered, then the network activity would be increased as taught

by Tapang to have said plurality of neurons comprise a plurality of interconnected neurons, each of said interconnected neurons being configured to fire when a corresponding excitation level thereof is greater than or equal to a threshold; and said increasing said network activity within said physical neural network includes lowering said threshold. The Examiner stated "the purpose of having the ability to adjust the threshold is critical in the development of the neural network."

The Applicant respectfully disagrees with this assessment and submits that the arguments presented above against the rejection to claim 13 apply equally to the rejection to claim 18. Tapang does not teach, nor suggest the use of nanoparticles as a synapse, which is inherent in claim 18 by its reference to the method of claim 13.

The Applicant also notes that the Examiner's argument that Tapang teaches said plurality of neurons comprises a plurality of interconnected neurons, each of said interconnected neurons being configured to fire when a corresponding excitation level thereof is greater than or equal to a threshold; and said increasing said network activity within said physical neural network includes lowering said threshold, is improper, because as explained previously, Tapang teaches away from nanoscale devices and provides absolutely no hint or teaching of nanotechnology. Tapang, 010:17-45 and C11:11-37 provides no hint, suggestion or teaching of nanotechnology. The EN arguing that Tapang illustrates the mechanics of what happens in regards to the threshold limit and increased voltages leading to the firing of the neuron is also flawed because this EN does not provide for any hint or suggestion of a nanoscale device and nanotechnology components, such as a nanotechnology based neuron.

The Examiner's EN argued that if all parameters were to remain constant with the exception of the threshold being lowered, then it is easy to see the neuron would fire earlier is improper simply because Tapang teaches away from nanoscale devices and cannot properly be combined with Bezryadln, Mehrotra, and/or Middleton as a basis for teaching a nanotechnology based neural network due to the lack of the essential teaching of nanotechnology by Tapang. Based on the foregoing, the Applicant submits that the rejection to claim 18 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 18.

Examiners response.

New art had been introduced so applicant's arguments are irrelevant.

28. Claim 19.

The combination of Mehrotra and Olson do not teach determining said excitation level of at least one neuron of said plurality of neurons based on a weighted sum of input signals received over respective nanoconnections, said nanoconnections being associated with respective weights, and adjusting each of said weights when said at least one neuron of said plurality of neurons and a corresponding one of said others of said neurons fire within a prescribed time interval.

Nagahara teaches determining said excitation level of at least one neuron of said plurality of neurons based on a weighted sum of input signals received over respective nanoconnections, said nanoconnections being associated with respective weights (**Nagahara,** p3836 C1:35 through C2:8, With the use of additional inputs into one electrode would be the equivalent to 'weighted sum' of applicant.), and adjusting each of said weights when said at least one neuron of said plurality of neurons and a corresponding one of said others of said neurons fire within a prescribed time interval. (**Nagahara,** abstract; The completed nanoscale wiring would be completed within seconds.) It would have been obvious to a person having ordinary skill in the art at the time of applicant's invention to modify combined teachings of Mehrotra and Olson by using combined input as combined weights as taught by Nagahara to determine said excitation level of at least one neuron of said plurality of neurons based on a weighted sum of input signals received over respective nanoconnections, said nanoconnections being associated with respective weights, and adjusting each of said weights when said at least one neuron of said plurality of neurons and a

corresponding one of said others of said neurons fire within a prescribed time interval.

For the purpose of using the combined electrical input as combined weights for use in a neural network.

In reference to applicants argument.

Regarding claim 19, the Examiner admitted that the combination of Bezryadin and Mehrotra do not teach determining said excitation level of at least one neuron of said plurality of neurons based on a weighted sum of input signals received over respective nanoconnections, said nanoconnections being associated with respective weights. The Examiner argued that Middleton teaches determining said excitation level of at least one neuron of said plurality of neurons based on a weighted sum of input signals received over respective nanoconnections, said nanoconnections being associated with respective weights. In support of this assertion, the Examiner cited Middleton, page 3199, C1:6-10. The Examiner argued that it would have been obvious to a person having ordinary skill in the art at the time of Applicant's invention to modify the combined teachings of Bezryadin and Mehrotra by summing the charges Is equivalent to determining the excitation levels as taught by Middleton to determining said excitation level of at least on neuron of said plurality of neurons based on a weighted sum of input signals received over respective nanoconnections, said nanoconnections being associated with respective weights, The Examiner stated that "for the purpose of determining an excitation level Is need as input for a threshold companion."

The Examiner also admitted that the combination of Bezryadin, Mehrotra and Middleton do not teach adjusting each of said weights when said at least one neuron of said plurality of neurons and a corresponding one of said others of said neurons fire within a prescribed time interval. The Examiner argued, however, that Tapang teaches adjusting each of said weights when said at least one neuron of said plurality of neurons and a corresponding one of said others of said neurons fire within a prescribed interval time. In support of this assertion, the Examiner cited Tapang C10:38-45, The Examiner also provided an EN, arguing that "adjusting the weight" of Applicant's invention is equivalent to "current charging the capacitor" of Tapang. The EN argued that since "weight" is voltage in this invention, by changing the "weight" one changes the voltage and thus the speed which the capacitor is charged.

The Examiner asserted that it would have been obvious to a person having ordinary skill in the art at the time of the Applicant's invention to modify the combined teachings of Bezryadin, Mehrotra, and Middleton by illustrating the fact if the weight is adjusted this effects the firing of the neuron as taught by

Tapang to adjusting each of said weights when said at least one neurons of said plurality of neurons and a corresponding one of said others of said neurons fire within a prescribed time interval. The Examiner stated that "for the purpose of making sure the neurons do not fire and thus be able to handle real world problems and not hang up waiting for neurons to fire".

The Applicant respectfully disagrees with this assessment and submits that the arguments presented above against the rejection to claim 13 apply equally to the rejection to claim 19. The Examiner asserts that Middleton teaches determining said excitation level of at least one neuron of said plurality of neurons based on a weighted sum of input signals received over respective nanoconnections, arguing that these claim limitations are taught by Middleton, page 3199, Cl: 6-10. This citation of Middleton discusses how the voltage on a single conducting quantum dot in an ordered array is found by summing over the capacitance and voltages of the other dots in the ordered array.

Middleton does not describe a synapsg, a Pgiron, or a neura network. Middleton does not teach any device that processes Information but rather is physically modeling the collective conductance properties of an ordered array of quantum dots. The Examiner is attempting to ascribe a similarity between a 'network' of two dimensional ordered quantum dots cooled to 200 degrees below zero and permanently bound to a chip surface under a vacuum with a physical neural network formed by the dipole induced aggregation of nanoparticles in a liquid solution between pre- and post-synaptic electrodes which are receiving electronic feedback from dedicated neural circuitry. The comparison between the disclosed invention and Middleton is most certainly not obvious because it does not make sense.

Tapang -does not teach or suggest the use of nanoparticles as a synapse. Tapang describes a method for refreshing capacitively stored synaptic weights (first sentence). It has been demonstrated that capacitively stored synaptic weights are limited in their ability to form very large and adaptive physical neural systems. The use of nanoparticles as a synapse alleviates this problem. In other words, Applicant is claiming a solution to a problem inherent in the design of Tapang.

The examiner asserts that 'adjusting the weight' of the applicant is equivalent to 'current charging the capacitor. If this were true, then the Examiner is asserting that a resistor is equivalent to a capacitor. The 'weight', as described by this patent application, is the dipole-induced aggregation of nanoparticles in a liquid across an electrode gap and the resulting resistance formed by this aggregation while still in the liquid.

Middleton does not provide for any teaching of determining said excitation level of at least one neuron of said plurality of neurons based on a weighted sum of input signals received over respective nanoconnections, said nanoconnections

being associated with,respective weights. Middleton, page 3199, C1:6-10 does not provide for any teaching or suggestions of neurons, weighted sums, and respective weights. As indicated previously, Middleton lacks a teaching of neural network and neural network components such as neurons. As such, it is improper to combine Bezryadin, Mehrotra and/or Tapang as suggested by the Examiner without the essential teaching of neural network and neural network components by Middleton.

The Examiner's argument that Tapang teaches adjusting each of said weights when said at least one neuron of said plurality of neurons and a corresponding one of said others of said neurons fire within a prescribed interval time is also improper because Tapang provides no teaching for nanoscale devices and in fact teaches from nanotechnology. Tapang simply does not provide for any teaching of nanoscale components. Tapang C10:38-45 cited by the Examiner also does not provide for any teaching of nanotechnology as taught by Applicant's invention. The EN, arguing that "adjusting the weight" of Applicant's invention is equivalent to "current charging the capacitor" of Tapang is also improper because Tapang provides for no teaching of nanotechnology. The Examiner has not provided any other evidence to the contrary. Based on the foregoing, the Applicant submits that the rejection to claim 19 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 19.

Examiner's response.

New art had been introduced so applicant's arguments are irrelevant.

29. Claim 20.

The combination of Mehrotra and Olson do not teach increasing said network activity within said physical neural network in response to a signal.

Nagahara teaches increasing said network activity within said physical neural network in response to a signal. (**Nagahara,** 'Increasing activity' and 'response to a signal' of applicant is equivalent to 'placement of CNT' and 'choice of frequency' of Nagahara.) It would have been obvious to a person having

ordinary skill in the art at the time of applicant's invention to modify combined teachings of Mehrotra and Olson by stating the relationship between electrical input and connections between electrodes as taught by Nagahara to have increasing said network activity within said physical neural network in response to a signal.

For the purpose of electrical input as a mechanism for generating a connection between electrodes.

In reference of applicants arguments.

Regarding claim 20, the Examiner admitted that the combination of Bezryadin and Mehrotra do not teach increasing said network activity within said physical neural network in response to a signal. The Examiner cited Middleton, page 3198, 01:21-25 and page 3199, C1:40-42 and provided an EN arguing that the "physical neural network" of Applicant's invention is equivalent to "two-dimensional arrays" of Middleton. The Examiner argued that it would have been obvious to a person having ordinary skill in the art at the time of Applicant's invention to modify the combined teachings of Bezryadin and Mehrotra by incorporating a dynamic network into a physical neural network as taught by Middleton for increasing said network activity within said physical neural network in response to a signal. The Examiner stated that "for the purpose of having a real world neural network that uses nanoparticles and nanoconnections".

The Applicant respectfully disagrees with this assessment and submits that the arguments presented above against the rejection to claim 13 apply equally to the rejection to claim 20. The examiner is asserting that the 'physical neural network' of Applicant's invention is equivalent to a 'two-dimensional arrays' of Middleton. The Examiner is attempting to ascribe a similarity between a 'network' of two dimensional ordered quantum dots cooled to 200 degrees below zero and permanently bound to a chip surface under a vacuum with a physical neural network formed by the dipole induced aggregation of nanoparticles in a liquid solution between pre- and post-synaptic electrodes which are receiving electronic feedback from dedicated neural circuitry.
If the physical neural network of the application is equivalent to the two-dimensional arrays of Middleton, then it naturally follows that: a liquid is a vacuum, a quantum dot permanently bound to the surface of a chip is equivalent to a free particle in a liquid, and an ordered two dimension array of permanently bound particles is equivalent to a three dimensional dipole-induced aggregation of particles between two electrodes. This, of course, is flawed. The

comparison between the disclosed invention and Middleton is most certainly not obvious because it does not make sense.

The Examiner's citation of Middleton, page 3198, C1:21-25 and page 3199, C1:40-42 and the EN arguing that the "physical neural network" of Applicant's invention is equivalent to "two-dimensional arrays" of Middleton are incorrect, because as explained previously, Middleton provides absolutely no hint or suggestion of a neural network. Middleton teaches collective transport in arrays of small metallic dots, which provides no basis and/or suggestion of a much different device known as a neural network. The two-dimensional arrays of Middleton cannot be utilized as a physical neural network because such two-dimensional arrays do not offer any neural network processing aspects. The Examiner has not provided any evidence to the contrary but merely made a statement that he "physical neural network" of Applicant's Invention is equivalent to "two-dimensional arrays" of Middleton without any explanation of why this is so. How do such two-dimensional arrays process information in a neural network manner? How could such two-dimensional arrays be modified to process information in a neural network manner? Where are the neural network components (e.g., neurons, synapses, etc) in such two-dimensional arrays? Based on the foregoing, the Applicant submits that the rejection to claim 20 has been traversed. The Applicant therefore respectfully requests withdrawal of the rejection to claim 20.

Examiners response.

New art had been introduced so applicant's arguments are irrelevant.

Conclusion

30. The prior art of record and not relied upon is considered pertinent to the applicant's disclosure.

-'Local Variation of Metal-Semiconducting Carbon Nanotube Contact Barrier Height':Gallo, Fretag, Johnson, Chen

-'An RF Circuit Model for Carbon Nanotubes':Burke

31. Claims 1-22 are rejected.

Correspondence Information

32. Any inquiry concerning this information or related to the subject disclosure should be directed to the Examiner Peter Coughlan, whose telephone number is (571) 272-5990. The Examiner can be reached on Monday through Friday from 7:15 a.m. to 3:45 p.m.

If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor David Vincent can be reached at (571) 272-3687. Any response to this office action should be mailed to:

Commissioner of Patents and Trademarks,

Washington, D. C. 20231;

Hand delivered to:

Receptionist,

Customer Service Window,

Randolph Building,

401 Dulany Street,

Alexandria, Virginia 22313,

(located on the first floor of the south side of the Randolph Building);

or faxed to:

(571) 273-8300 (for formal communications intended for entry.)

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Peter Coughlan

4/3/2006

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